LIVING IN THE AGE OF MACHINES

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Globe Oil and Refining Co.

Towers and Pipes in a Refinery where 500,000 gallons of crude oil a day are changed into gasoline and other products much used in the age of machines.

OUR WAYS OF LIVING

Living in the Age of Machines

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Foreword

Living in the Age of Machines is the third volume in a series of books in social studies for four years of the elementary school. The books present carefully selected and organized materials which may serve as the core of the social-studies curriculum; or as "social cement" to bind together and vitalize the customary courses in history, geography, and citizenship. In the series, the authors have sought to avoid the repetitions and omissions in many traditional courses of study; they have sought to provide a foundation for the development of a well-articulated and significant curriculum in the social studies.

The title and the central topic of the series is *Our Ways of Living,* and the four volumes cumulatively build up this central theme. The first volume introduces pupils to the concept of variation in ways of living, through a series of units showing *Ways of Living in Many Lands.* The second volume presents basic elements of history, geography, and civics in a series of units on *Where Our Ways of Living Come From.* The third volume analyzes basic characteristics of modern life through materials on *Living in the Age of Machines.* The fourth volume presents aspects of mankind's aspirations and achievements in the arts and sciences, making possible *Richer Ways of Living.*

The series is unified by its organization around a central, cumulative theme. And not only does its controlled articulation embrace the elementary school; the materials for these years are planned in relation to the materials that pupils will study in the junior and senior high schools. The authors have envisaged the social-studies curriculum from the earliest grades to graduation as a steady unfolding of the story of human affairs. This series is a planned whole in its own right and at the same time is a strong foundation for the continuance of social education.

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A second feature of the books is their wide range of social content. They present the best materials from the traditional courses of study, but omit considerable old material which has been conspicuous for its lack of value or of meaning for pupils. In its place will be found materials from the newer researches of history, geography, and government, and from the newer social sciences of economics and sociology. Among the innovations of content are: a discussion of group life and citizenship; material on language as a social institution; a unified study of automobile, railroad, water, and air routes of the world; material on the harnessing of power and the search for still better ways of harnessing it; the effects of industrial life on communities and on individuals; the story of human friendliness; the significance of the rise of public libraries, museums, and schools; the social effects of the rise of science; the wise use of natural resources; and government as a social process rather than a political framework.

Although the traditional labels and organization of materials are not extensively used in the series, the pupil is introduced to basic elements in the broad social heritage. The books incorporate significant and typical materials from the full range of human history, from the story of our national development, from the great areas of human geography, and from the complicated processes of ordinary group living. The content of the books is intentionally representative of that extraordinarily broad field which has been well called "the seamless web of human experience."

Ideas and social insights and skills, as distinguished from "raw information," constitute the real objectives of social-studies teaching, and these books are organized to help attain these objectives. In spite of the breadth of content of the books, they are not mere collections of far-flung facts. The books are built on the principles of *direct teaching,* with all the content focused on the objectives to be attained.

Each book of the series contains six units. These units are not merely mechanical subdivisions of the books, but are carefully and critically constructed. *A unit is a body of subject matter, plus an implementing group of learning-activities, every detail of which is focused on a central cluster of ideas.* The understanding of these ideas, which are sometimes referred to as concepts or generalizations, is the primary objective of social-studies instruction; the subject matter of the units and the suggested pupil-activities have been selected and organized on the basis of their direct relation to these ideas. Non-pertinent information and activities have been excluded.

Each unit is presented as a series of short, dramatic stories. Most of these stories present concrete and vivid details of information which *are illustrative of* the major ideas of the unit. Each small group of stories leads up to a generalization, and this generalization or concept is then explicitly stated in a very brief generalizing story (the title of which is printed in Italic type in the table of Contents of the book). These generalizing stories formulate the ideas which the preceding stories have equipped pupils to understand. The progression of stories through the unit leads to a final generalizing story in which the cluster of ideas of the unit is again emphasized.

The arrangement of the units reflects the intimate relation between subject matter to be studied and pupil-activities through which it is studied. The study activities suggested in connection with each unit are selected to emphasize the relationships existing among the stories and to focus on the idea-objectives. The study activities are also designed to give pupils training in the skills of study and of intellectual operation and social participation without mastery of which they cannot function as constructive members of society.

Books, no matter how well constructed in terms of educational objectives, must be of challenging interest to pupils if they are to be psychologically effective. The authors of this series regard the unit organization as described above, as psychologically sound. To enhance the interest of the books they have, in addition to this organization, sought to control and develop pupils' vocabulary, not alone by restricting the choice of words used but also by careful and functional explanation and controlled repetition of basic social-studies terms. Much attention has been given to grammatical simplicity, and even more to an effective style of writing. The material is presented in concrete rather than abstract "textual" terms. Boys and girls and their activities, of the past and of the present, have been introduced into the books; words and pictures have been integrated. The authors have not "written adult material down for children" but have written directly for boys and girls. They have tried to live up to the advice of a wise elementary-school teacher who said to them, "Write every story as if the children themselves were to live it!"

The books are the work of a group of people co-operating closely over a period of years. All the authors and collaborators participated in the planning and writing of the stories; the result is a unified variety of approaches and treatment reflecting the wide background and teaching experience of the whole group. During the years in which they have worked there have appeared the report of the American Historical Association's Commission on the Social Studies in the Schools, the *Fourteenth Yearbook* of the Department of Superintendence, and various publications of the National Council for the Social Studies. To these reports the authors of *Our Ways of Living* are deeply indebted for guidance. No less is their obligation to the many school systems which have produced elementary-school courses of study in social studies in recent years. These books have drawn heavily upon the experiences embodied in those curriculum-bulletins, as well as upon the co-operation and insight of classroom teachers and supervisors. Many sections of the books have been subjected to the test of practical use. To teachers in the school systems of Detroit, Michigan, and of Brookline and Reading, Massachusetts, and to teachers who have participated in courses on the social-studies curriculum at the Harvard Graduate School of Education, the obligation of gratitude is very great.

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To the Boys and Girls

What would our ways of living be like if we had no machines? There would be no radios or electric lights or skyscrapers. There would be no telephones, no furnaces, no factories. All our clothes would have to be made by hand, all our books and newspapers printed by hand, and all our furniture put together with hand tools. There would be no airplanes or automobiles or railroad trains.

People sometimes say today that "We live in an age of machines!" When we think how many of our ways of living depend on machines, we know that the saying is true. We cannot understand our ways of living until we know about the things machines do for us.

This book tells of some of our ways of living in the age of machines. There are six units in the book. The first one tells about communication, and how machines have helped us to exchange ideas more easily. The second unit tells about transportation. It tells how trains and steamships and automobiles and airplanes have become parts of our ways of living. Unit III tells how the invention of machinery helped people to produce more goods. It tells about some of the great inventions which have made factories possible. Unit IV deals with "The Harnessing of Power." Its stories tell how we now depend on the power of winds and flowing water, of coal and steam and oil, and of electricity.

Think how much the power in all these things works for us!

In Unit V there are stories which tell how the age of machines has changed communities and cities. You will find there stories about street lights, about city water systems, about slums, and about playgrounds. Finally, Unit VI tells some of the ways in which the age of machines affects *you*. After you read these stories you will see how many of your ways of living are made by the "age of machines."

Many "Things to Do" will be suggested to you by the stories of the book. You will enjoy the pictures and maps. Why not make in your classroom this year, while you are reading this book, a Museum of the Age of Machines? What things do you think belong in such a museum?

UNIT I

COMMUNICATION

GENERAL STORE

1

Tongues Are Wagging

It was the first day of school. Into Miss Abbott's cheerful classroom came many sun-tanned boys and girls, happy to see one another again. They were talking of the things they had done during the summer vacation. It seemed as if everyone was fairly bursting with things to say.

Nancy told of her first ride on a donkey. Carl proudly described a fish "as big as a man" that he had caught while fishing with his uncle. When the class came to order, Miss Abbott smiled at the pupils and said, "I heard the story Carl was telling about a big fish. I'm sure many of you had vacation experiences as interesting as his. Don't you think it would be a good plan for all of you to tell the class about your summer vacation?"

"Oh, yes!" said the girls and boys, nodding their heads. Every pupil had something interesting to tell. Franklin had helped his father build a rock garden and a pool for goldfish. Lois had been at camp and had learned to make drinking cups of birch bark. Nancy and Dick, who were cousins, had spent the

---

Credits: *Keystone View Co.; Armstrong Roberts; Ewing Galloway*

The pictures on the opposite page show several means of communication: Indian smoke signaling, Babylonian writing, Pony Express of 1860, and the modern telephone and radio.

Harvey, in Paris, finds an officer who can speak English. In France a police officer is called a *gendarme*. A street is called a *rue*.

summer on their grandfather's farm. Mary had made a very fine collection of pressed wild flowers.

The most exciting adventure of all had happened to Harvey. He had gone to France with his father and mother. "I got lost one day in Paris," Harvey said. "I wandered around the streets for a long time before I found a policeman who could understand English."

"Were you frightened, Harvey?" asked Miss Abbott.

"Yes, I was," admitted Harvey. "It's no fun being lost like that and not being able to make anybody understand what you're trying to say. At first I thought everybody was stupid. Speaking English did not help me at all, because the French people I met didn't know what my words meant. They used words of their own that I couldn't understand. I was certainly glad when I found somebody who could speak English."

"Words are useful when you know what they mean," said Miss Abbott. "Have you ever wondered how people would get along if they didn't know any words at all? If we didn't have words we couldn't talk with one another. Without words there could be no books. Without words people could not exchange ideas easily."

"How did speaking and writing start?" asked Lois.

"That is a good question," said Miss Abbott. "Suppose Carl wanted to tell about the big fish he had caught but he couldn't speak or write! How would any of us get along without words? The story of how we learned to speak is very interesting."

"Couldn't we study that story?" asked Carl. "I'd like to know how people learned to speak and write."

"I'd like to know why my words are so different from those the Frenchmen use," added Harvey.

Miss Abbott looked at the class. "How many of you," she asked, "would like to learn where words come from?"

Every hand went up. "Very well," said Miss Abbott. "That will be a good way to begin our year's work together. We'll find out how words were made, why they mean so much to men, and how important they are in our ways of living."

As you study the stories in this book, you will enjoy doing some of the following activities.

A Class Bulletin Board

On your Bulletin Board post pictures, maps, and clippings that you and your classmates find, showing or telling about the actions and things you will read about in this book. Probably you will find so many interesting pictures and clippings that you will want to change them often. Appoint a committee to take charge of the Bulletin Board, to keep it neat and interesting.

Your Notebook

Make a notebook to keep your own pictures, clippings, stories, poems, summaries, and charts. Try to see how many interesting and worth-while things you can do for your notebook. Try to make your book different from the others. Ask the art teacher to help you make the cover. She may help you with your printing and pictures also.

A Class Book

You may want to make a large class book in which to keep the best work of the class.

A Class Museum

Have a table or shelf in your classroom on which you may keep the best things that are made or brought in by the class. Invite the other classes to visit your exhibit.

Word Study

Look up the words *communication* and *conversation* in the dictionary. Act out the meaning of the words before the class. Use the words in sentences.

Talking Time

Describe how Harvey must have felt when he was lost in Paris. Have you ever been unable to make people understand you?

2

Talking Time

The twins, Carl and Enid, were in Miss Abbott's class. The evening of the first day at school they were sitting with their father and mother in the porch swing. Dinner was over, the sun was going down, and, as usual, the family were talking. The twins always felt that the talking time at nightfall was the happiest hour of the day.

"Aren't words queer?" said Enid, who had been thinking about the talk of the class at school that day.

"Yes, they are," answered Carl. "Take *beanbag* for instance: just seven letters put together to make a sound that really is quite funny when you think about it. But the sound actually means something. When I say 'beanbag' you know what I mean."

"Yes, and if I said 'bag of beans' it would mean something altogether different, but you would know what I meant by that, too. I guess our words stand for our thoughts," said Enid.

"That's a very good statement, Enid," said Father. "Language is either the spoken or the written expression of our thoughts. And language, you know, is made up of words."

"When did language begin, Father?" asked Carl.

"No one really knows, Carl, but it must have started very early in primitive times, just as soon as people began living together."

"Of course, Father means that spoken language started then," said Mother. "Written language did not begin until long after people had begun to talk."

"I wonder why people began to speak," said Enid.

"If people are to live together they have to talk with one another," replied Father. "While early people were learning to get food and water, to find shelter, and to protect themselves from wild beasts, they had to express their ideas. Can you imagine our own family living together day after day without our being able to speak with one another?"

"I can't!" exclaimed Enid.

"I wonder *how* language began," said Carl.

"Perhaps before people began to make sounds," replied Father, "they exchanged their ideas by making signs and faces at one another. We sometimes use signs or motions. For instance, we motion to a person to come to us or to go away."

"Perhaps," said Enid, "while a hungry primitive family was searching for food one day, the mother found a big patch of juicy berries. To call the family into the patch she made a very happy sound. Maybe that happy sound was the very first word spoken."

"That's a good guess," laughed Father.

"Or, maybe," said Carl, "a dangerous beast was coming toward the family one day. The father made a sharp, quick sound to give them warning. They saw the beast and hurried into their cave. That sharp sound might have been the first word."

"One guess is as good as another," said Father, "for we really don't know how the first words started."

American Museum of Natural History

Primitive men needed fewer words than we have today. How do you suppose one of these men told the other about the bear?

"Men did not stop using motions and signs the moment they began making sounds for words," said Mother. "Signs and motions remained a part of language for a long time. In fact, it is said there are tribes today whose members cannot understand one another in the dark, because they have to use motions to help them exchange their ideas."

"Do you suppose," asked Carl, "if I'd been born in one of those tribes, instead of among people like us, that I'd have learned to speak?"

"You would have learned how to make the same sounds the people of the tribe use in talking with one another," suggested Mother. "But you would not have learned to speak as we do."

"I once knew an American boy who was brought up in China and had a Chinese nurse," said Father. "The boy could speak Chinese better than English, because he heard and used Chinese oftener than English."

"How did there come to be so many different languages?" asked Enid.

"The people who make a study of languages," explained Father, "say that people who lived in separate parts of the earth and did not exchange ideas with one another began to use different sounds for the same idea. For instance, each different group of such people might have a different sound to stand for *water*. In the various languages of today most of the words are different. For example, in the English language we have the word *bread*. The Germans use the word *brot* (pronounced brōt) for bread; the French, *pain* (pronounced like the first two letters of *pantry*); the Italians, *pane* (pronounced pä'nĕ); and the Russians, *chleb* (pronounced κlĕb).

"Primitive men did not use many words. They did not need to. But the language of a civilized nation today is made up of many thousands of words. How do you suppose a language grows? There are several ways in which words have been added to our language, and are still being added to it.

"We invent new names for new things; for example, *movie, talkie, airplane, taxicab, rayon, zipper.* Sometimes this is done by putting two old words together, as *airplane, standard-bearer, streamlined.*

"Very often we borrow words from other languages, either just as they are without changing them, or with only a slight change in sound. Among the many American Indian words we use are *squash, canoe, moccasin, Mississippi;* Spanish words, *stampede, rodeo;* French, *bureau, prairie, bouquet;* Latin, *doctor, exit, circus, omnibus;* Greek, *telephone, alphabet, hero.*"

As Father stopped speaking, the twins heard the clock strike. That sound meant that talking time was over and bedtime had come for them.

"Well," said Carl, "I'm glad people learned to speak. Without language we couldn't have schools, or talkies, or radio programs."

"Or our talking time!" exclaimed Enid.

"Or anything else that is worth while," said Mother, "for our ways of living depend very much on language."

The next morning at school Carl and Enid told the members of Miss Abbott's class how language started and grew. Can you tell the story to your class?

A Communication Game

Without speaking or writing any words, make a classmate understand that you want him to

(1) Come to you;
(2) Look at something on the ground;
(3) Keep quiet;
(4) Keep back out of sight.

A List of New Words

In your school work and in your reading you often meet new words. If you are not sure what a new word means, look it up in the dictionary. Write its meaning or definition in a special part of your notebook called *New Words I Have Learned.*

Comparing Words

Maybe some members of your class are so fortunate as to know more than one language. Find out how many languages are known to your class. Then take some common things (such as bread, water, fire, machine, school) and see what different words stand for them in the different languages.

See if you can find out how to say "Hello," "Good-by," and "Merry Christmas" in several languages.

Acting Time

Ask your teacher if you may act out some scenes showing how language may have started.

3

A Great Treasure

Fortunately for us, man learned to do something with his throat and tongue besides eating and breathing. He learned to use the muscles of his mouth and throat to make sounds. Because he could think, he learned to make certain sounds stand for ideas. Language grew very slowly from easy sounds to more difficult sounds. At first people used only simple words. Later they learned to speak in sentences.

If men had not learned to use language, we should probably be living as our primitive ancestors did. Language helps men to exchange ideas, or communicate with one another. We could live fairly well without trains or electric lights or automobiles, but without language we should find it difficult to live.

We use language so much and so easily that we often think no more about it than we do about the air we breathe. We often forget how important language is to us and to our ways of living. Language is really one of our greatest treasures. We all need to learn to use it well.

Talking Time

Why is language one of our greatest treasures?

Your Words

How many words do you know?

Make a list of the interesting words you use during a day at school. Select five of them, look them up in the dictionary, and tell the class all you can find out about their history and their meaning.

Drawing Time

Can you draw a picture to show one of the following?

Primitive men communicating before language started.

The first word.

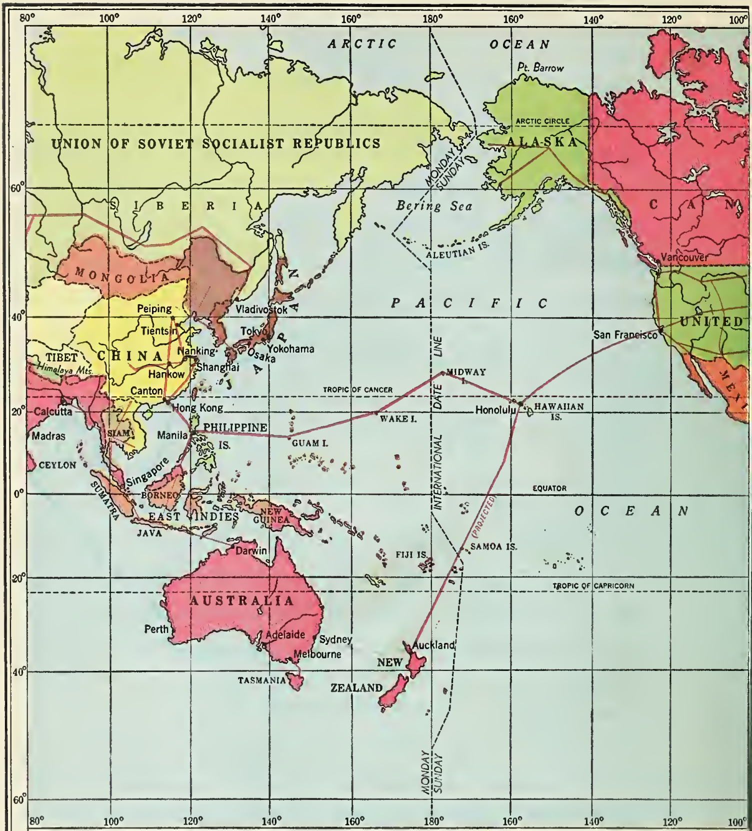
Language grows.

Language is important to us.

Ask your teacher if you may paste the best pictures on a strip of wrapping paper to make a border for your room. Later add the border to your museum.

Map Study

When you read, on earlier pages, such names as France, China, Germans, and Italians, did you remember just where France, China, Germany, Italy, and other countries are located? Can you point to them on a globe or on a wall map, or on the map on pages 18–19? This map, and the maps on pages 40 and 136–137, will be convenient for reference in reading many later stories. Could we use maps if we did not know any words?



COUNTRIES OF THE WORLD
AND
CHIEF STEAMSHIP AND AIR ROUTES

(For Names of Continents, see page 146)
(For Rivers in Europe, see page 40)

🟩 United States and Possessions
🟥 British Empire
🟨 France and Possessions
🟫 Empire of Japan
🟧 Italy and Possessions

Other Countries are shown in colors of lighter tints.

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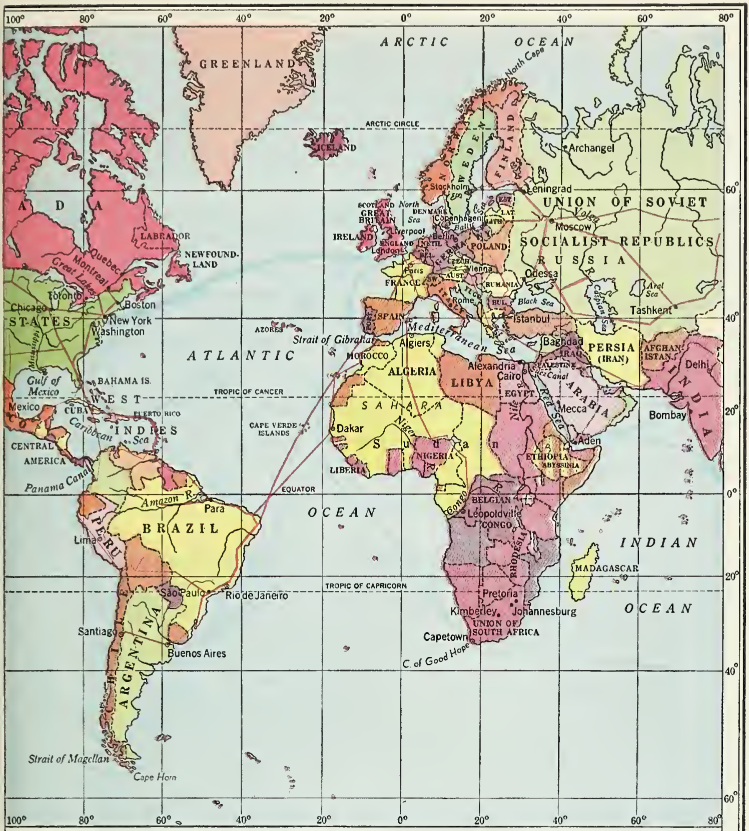


— Principal Steamship Routes

The more important routes are shown by wider lines. The width of these lines indicates the relative importance of the route in world commerce.

— Principal International Air Routes

Abbreviations:

AUST.	Austria	LITH.	Lithuania
BEL.	Belgium	NETH.	Netherlands or Holland
BUL.	Bulgaria		
CZECH.	Czechoslovakia	PORT.	Portugal
EST.	Estonia	SW.	Switzerland
LAT.	Latvia	YUGO.	Yugoslavia

4

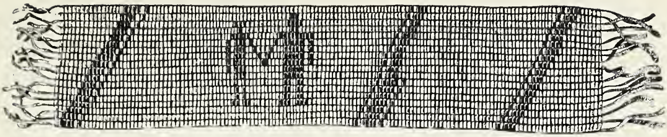
How Men Learned to Write

After studying how men learned to speak Miss Abbott's class wanted to know how men learned to write. With Miss Abbott's help, the boys and girls found a great many stories about how men learned to write. Should you like to read the stories they liked?

Very early primitive men knew how to draw pictures. At first people drew pictures just for fun, as little children draw pictures today. Later, they made pictures to help them remember things.

© *Field Museum of Natural History*

This is a picture of a primitive man drawing on the wall of his cave home. He is using a crude chisel



This is a wampum belt made by a North American Indian to show friendship.

to cut the picture on the wall. Perhaps the man wants to remember something about the big animal he is drawing. He may have seen the animal while out hunting. He may even have killed it. Perhaps his picture is to show how he killed the animal.

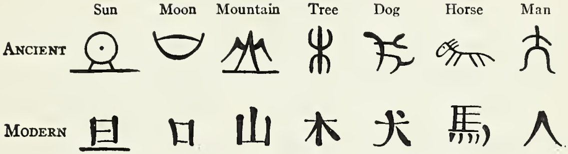
When men learned how to draw pictures to help them remember things, they had taken the first step toward learning how to write. It was easy for men to draw pictures of animals and things. But later they wanted to draw pictures which stood for ideas. That was harder to do. For instance, how could they draw a picture that stood for a *friend,* or for an *enemy,* or for the idea of *early*?

A friend would welcome you with outstretched arms; therefore, a man with his arms held out became the picture for *friend.* An enemy might try to shoot you, so an arrow became the sign for *enemy.* Because the sun rises early in the morning, a picture of the sun just peeping over the horizon stood for *early.* We call these pictures "idea-pictures." When men had learned to make pictures which stood for ideas, they had taken the second step in the long road toward writing.

Many years after they had learned to make idea-pictures, men began to think about the sounds of words. They began to draw pictures to stand for syllable sounds. For example, in our language a picture of a bee might stand for the syllable *be-*. In the word *belief* a picture of a leaf might stand for the last syllable. A picture of a gun might stand for the last syllable in the word *begun*. We call such pictures "syllable-sound" pictures. When men learned to make syllable-sound pictures they used them with their other writing pictures. Syllable-sound pictures were the third step on the road to writing.

After people had used syllable-sound pictures for a long time they learned to make sound pictures that stood for just one letter. This was a great step forward on the long road toward writing. If they had made a picture of every sound in their language they would have had an alphabet. With an alphabet they could have thrown away all of the other pictures. At one time the Egyptians (ė-jĭp′shănz) had about five hundred writing pictures. Twenty-four of these pictures stood for sounds of the alphabet. By thinking a little harder the Egyptians could have made a letter for every sound in their language. But the Egyptians thought their picture-writing was very beautiful and did not want to stop using it.

For a long time, then, men used four kinds of pictures in their writing. First, there was the picture of the thing itself, such as an animal; second, pictures that stood for ideas, as the rising sun for *early;* third, pictures that stood for the sound of one syllable of a word, as the bumblebee might stand for the syllable *be-* in our language; and fourth, pictures that stood for the sound of just one letter, such as F. We call these pictures "picture writing."



This is some picture writing of the Chinese people.

Just as men living in different parts of the world seemed to use the same steps in learning to speak, so men, no matter how far apart they lived, used the same steps in learning to write. People as far apart as the American Indians, the Chinese, the Egyptians, and the Babylonians (băb-ĭ-lō′nĭ-ănz) all started to write by using pictures.

This picture writing was found on a temple which belonged to some Indians of Mexico more than 500 years ago.

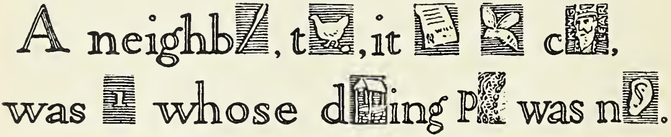
Talking Time

In the encyclopedia find out more about Indian, Chinese, Babylonian, and Egyptian writing. Tell the class what you find.

Puzzle Pictures

Find in newspapers and children's magazines puzzles which have pictures for words and pictures for syllables. Paste them in your notebook. Maybe you can make up a story or message in pictures and syllable writing. Put it in your notebook too.

Can you read the following sentence, written partly in pictures for words and parts of words?



Remembering the Main Ideas

See if you can write down clearly and briefly the steps men took in learning to write.

5

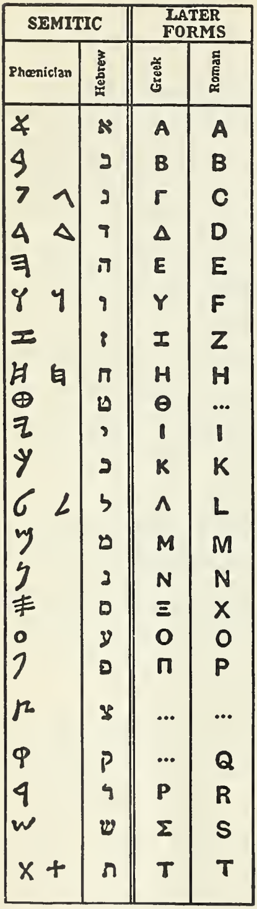
The Story of the Alphabet

The Phoenicians (fē̇-nĭsh′ănz) were very good sailors. As you know, they were among the earliest traders and travelers. As years went by they steered their ships into every harbor in the Mediterranean Sea and even sailed out into the Atlantic Ocean.

The busy Phoenician tradesmen had to remember many things. Picture writing for such busy men took too much time and space. The merchants were always wishing for an easier way to mark their wares, to keep their accounts, and to write their messages.

At last, while trading among the Semitic (sē̇-mĭt′ĭk) tribes of southwestern Asia, whose language was much like their own, some Phoenician traders came upon a new and easy way of writing. The new way contained no pictures, no idea signs, and no syllable sounds. It was made up of letter signs only.

The new way of writing was the first alphabet. It contained just twenty-two signs, some of them borrowed from Egyptian writing, but each standing for one sound in the language of the Semitic tribe. These sounds were put together to make words. With these twenty-two letters the scribes, or writing men, of the tribe could write more quickly and easily than by using the five hundred writing pictures of the Egyptians.



SEMITIC		LATER FORMS	
Phœnician	Hebrew	Greek	Roman
𐤀	א	A	A
𐤁	ב	B	B
𐤂	ג	Γ	C
𐤃	ד	Δ	D
𐤄	ה	E	E
𐤅	ו	Y	F
𐤆	ז	I	Z
𐤇	ח	H	H
𐤈	ט	Θ	...
𐤉	י	I	I
𐤊	כ	K	K
𐤋	ל	Λ	L
𐤌	מ	M	M
𐤍	נ	N	N
𐤎	ס	Ξ	X
𐤏	ע	O	O
𐤐	פ	Π	P
𐤑	צ	...	...
𐤒	ק	...	Q
𐤓	ר	P	R
𐤔	ש	Σ	S
𐤕	ת	T	T

These alphabets show where most of our letters came from.

The news of the alphabet was carried to other Phoenicians and, as time went on, all of the Phoenician scribes learned to use it. Wherever the Phoenicians went, they took with them goods and ideas from different parts of the world. Other people began to use their way of writing.

The Hebrews, another Semitic people, were the first of the ancient peoples to copy the new alphabet; but they made some changes in the letters or signs. The Hebrews also gave each sign a name which began with that particular sign. For instance, the Hebrew word *aleph* (which the Hebrews pronounced ʀä′lĕf), meaning "ox," began with the first sign of their alphabet, so they named that first sign *Aleph*. And since their word *beth*, meaning "house," began with the second sign of their alphabet, they called that second sign *Beth*. When the Hebrew boys learned to repeat the letters, they called them by their names. They said, "Aleph, Beth," and so on. The Phoenicians thought this was a good way to remember the signs, too, and they learned to say the alphabet.

The Greeks had settled as farmers in the lands around the Aegean (ē-jē′ăn) Sea. But many of them became traders and merchants. As their life grew busier they needed an easy way of writing. In time they learned to use the alphabet. Some of them had heard the Phoenician schoolboys repeating the names of the writing signs, but the Greeks preferred to say "Alpha, Beta," instead of "Aleph, Beth." In time, too, these two words were joined together to make the name *alphabet* for all the letters.

The Phoenician and Hebrew alphabets had letters only for consonant sounds such as K, B, S, T. The Greeks wanted letters also for vowel sounds such as A and O. They changed the meaning of some signs, made up some new signs, and threw others away. When they were through with the changes, the Greeks had added the vowels A, I, U, two kinds of E's, and two O's.

The Greeks traded and made settlements in many places along the coast of the Mediterranean Sea. On the Italian peninsula they met the Romans. The Romans had not yet learned to write. But as they grew more powerful, their leaders could not depend on their old ways of remembering things. Finally, they learned to use the Greek alphabet.

Like the Greeks, the Romans found that they had to make some changes in the alphabet to fit it to the sounds of their language. For example, they put in the letters Q and Y, which had been left out by the Greeks. Some of the Roman letters look quite different from the Greek, as you can see (page 26).

The Romans became very strong and powerful. They finally ruled over a very large part of the ancient world. Their power extended to all the countries around the Mediterranean and Black seas and even into Britain (map, page 40). Wherever they went, they taught their ways of living to the people they conquered, and therefore many people learned to use the Roman alphabet.

The Britons had to make very few changes in the Roman alphabet to fit their language. The alphabet we use today came from the Britons. Although we have more letters than the Romans, none of them is entirely new. We have made more letters by writing some of the old letters in more than one way. For instance, the letter J used to be the same as I. About three hundred years ago someone put a little curve on the I and made J. The Romans always pronounced V like W when it was a consonant and like U when it was a vowel. But they did not have the letters U and W in their alphabet. We wanted all three letters, so we put into our alphabet W and U, besides V.

When we compare the alphabet with picture writing, we realize how very simple and easy it is. But no matter how easy it is, it is very important. With just twenty-six signs we can write all the words in our language. The alphabet makes writing so easy that every boy and girl who goes to school can learn to write. It makes reading easy, too, because we can easily learn how each word is spelled. We do not have to guess at what pictures mean. Without an alphabet, learning to read and write would be hard, hard work.

Using the Dictionary

Do you know the meaning of *consonant* and *vowel?* They are hard words to explain, but it is easy to give examples of them.

A Travel Map of the Alphabet

Locate on the map on page 40 all the countries named in this story. Be able to tell what happened to the alphabet in each country. Trace the route the alphabet took in traveling from the Semitic tribes to us.

For Your Notebook

In your notebook write several letters which are alike in the Greek and Roman alphabets. Write several letters which are different in the two alphabets.

Acting Time

Can you act out a play showing how the alphabet helped the Phoenicians?

The men on horseback are leaders of a barbarian force that is taking a Roman town. The barbarians had their own language. Do you think they would want to learn Latin, the language of the Romans?

6

Interesting Facts about Our Language

You have learned how very large and powerful the Roman Empire became and how people all over it began to use the Roman alphabet. But the power of Rome did not last forever. About 500 A.D. the Roman Empire was conquered by Teutonic (tū̇-tŏn′ĭk) tribes that invaded it from the north. The people living in the Roman Empire did not understand the language of the Teutons (tū′tŏnz), and called them *barbarians*, which meant "foreigners" or "strangers."

The barbarians were not educated, and their ways of living were very crude. They did not like many of the fine things they found in the Roman Empire. They destroyed many things or let them go to ruin. It took them many years to understand the Roman ways of living. Finally, however, the Teutons learned many of the good ideas of the ancient nations, which helped them to improve their ways of living. The years in which the barbarian tribes were becoming more civilized we call the Middle Ages. The Middle Ages lasted about a thousand years, from about 500 A.D. to about 1500 A.D. During that time many important things happened which really helped to give us the language we use today.

The Romans always used the letters I, V, X, L, C, D, and M of their alphabet for numbers. People who took the Roman alphabet took their way of figuring, also. The Roman numbers for 1 to 12, as you can see on some clocks, are I, II, III, IV, V, VI, VII, VIII, IX, X, XI, and XII. We still often use Roman numbers when we put the date on a new building. For example, MCMXXIX is cut in stone for the date 1929. But we can be glad that we do not use the Roman numbers for our arithmetic. How should you like to multiply XXIX by XIX instead of 29 by 19?

During the Middle Ages some Mohammedans from Africa conquered Spain. They brought with them an alphabet and figures which they had learned from the Arabs (ăr′ăbz). The Arabs were very intelligent people and knew a great deal about mathematics. They had worked out a very simple kind of arithmetic, using the set of figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 0. When the people of Europe saw how easy the arithmetic of the Arabs was, they slowly gave up the hard number system of the Romans and began to use the Arabic system. The Arabic system is the one we use today.

In writing, the Romans always used capital letters. They had no small letters. When they carved letters on their buildings, they made them stand up very straight. When they wrote on parchment they changed the shape of their letters a little and slanted them. From these slanting letters came the idea of small letters. Capital letters took so much time and space that people were glad to use small letters. During the Middle Ages the scribes learned to use capital letters only for the beginnings of words which were the names of people, places, and things, and for the beginning of sentences. About the time they began to use small letters, the scribes also began to use punctuation marks to make the meaning of their sentences clear.

This drawing from an old book shows a scribe of the Middle Ages busily writing.

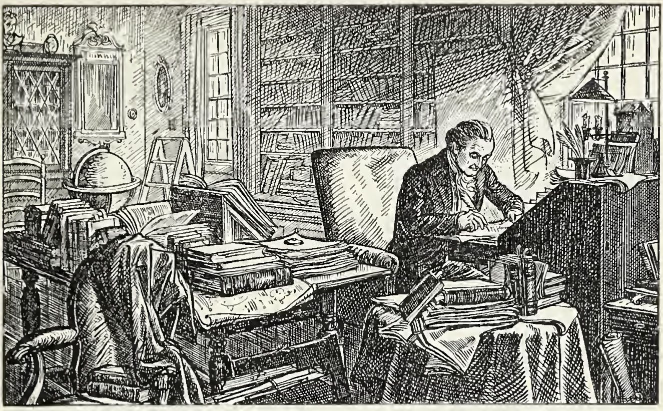
The scribes during the Middle Ages learned to make their writing look very beautiful. About eight hundred years ago they began to give their letters a different form and to make them very black. This kind of writing has three names: Gothic (gŏth'ĭk), Old English, and Black Letter. The very fact that it is called Old English tells us that it was used in olden times by the

English. Today Old English letters are used only by printers for special books and headings. The Germans kept the Black Letter type many years longer than the other nations and still use it a great deal.

Old English letters are hard to read and hard to write. When more people began to read and write, letters were made more simply. However, it was once very fashionable in America to write with many beautiful curves and flourishes. Today we have a very simple way of writing which is easy to read.

During the Middle Ages there was really no right or wrong way of spelling many words. Everyone spelled the words just as he thought they should be spelled. Many words also were pronounced differently by different people. To spell "eggs" some people wrote "eggys," some wrote "eggs," and others wrote "eyres." If they wanted to put an e at the end of a word they did so. If they wanted to write two n's, two t's, or two s's, they did as they pleased. We can find "engliss," "englysche," "englysshe," and many other spellings for "English."

Finally an English dictionary was published. The first English dictionary was written by Samuel Johnson in 1755. The next English dictionary was written in America by Noah Webster in 1806. These men had to look through the books of the very best English authors to learn the meanings of words and the best way to spell them. If they found a word spelled in different ways, they usually took the way which was



NOAH WEBSTER at work writing his dictionary.

used most. Thus "eggs" and "English" were chosen as the best spellings of those words; and "fysshe" became "fish." Today we have many dictionaries, but all of them spell most of our words the same way.

We still find it difficult to spell some of the words in our language. The early English people sounded the k in the word "knee" (then pronounced k'nē). Today, although we say nē, we still spell "knee." There are other words, too, that have in them silent letters which used to be pronounced. The gh in "night" used to be given a very hard sound, but today it is silent. We can find many words that end with silent e's, such as "time," "single," and "senate." However, we ought to be glad that we have a dictionary to tell us the correct way to spell words.

When Rome was ruling the ancient world, and for many years after, Latin, the language of the Romans, was the official language of western Europe. That is, all the business of the courts, all of the important writing, and much of the trading at the ports was carried on in Latin. Later, when France became an important nation, the French language took the place of Latin and became the official, or court, language. But now English has taken the first place among the languages of the world.

Today, the English language is spoken by more people than any other language. The English-speaking people of the United States and Great Britain and her colonies number more than 200,000,000. They are not the only people, however, who know how to speak English. Almost all the statesmen of Europe and South America, and many of Asia, speak and read the English language in order to carry on their work. The captain and many of the crew of every large ocean vessel speak English, for it is the language in which the trading is done in most of the ports of the world. School children in many countries learn the English language in addition to their own language.

When we study how our language and writing came to us, we learn many interesting facts. Do you know that our language is constantly changing? New words are being added all the time, and the meaning of a word sometimes changes. Dictionaries are often rewritten to fit the changing language.

Writing the Date

In your notebook write the present year in Roman numbers.

Numbers

Look in the encyclopedia under "Numbers" and make a chart showing how our way of writing some of the numbers has changed.

If you can find a picture of a monument or a tablet with words on it, all in capital letters, copy it in your notebook. Beside it, or below it, make another copy using small letters. Which is easier to read? Can you tell why?

Talking Time

Give an oral report on "Silent Letters in Our Language." Illustrate your talk by writing on the blackboard several silent-letter words which you find in your dictionary, such as "knight," "Wednesday."

Try to find out why we say ī′ern for "iron." We do not say ī′ron.

See if you can find a copy of a dictionary published before 1900. Compare it with your new *Dictionary for Boys and Girls.* Make a list of some of the new words you find in your new dictionary that were not in the older one.

Kalki receives a message to carry for his king.

7

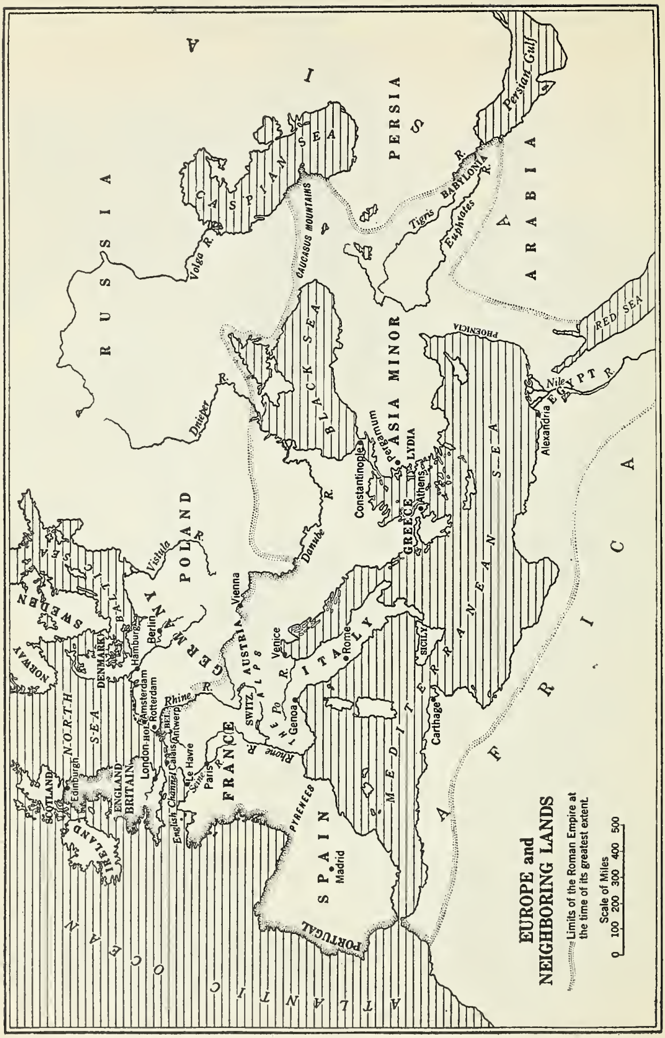
Carrying Mail Then and Now

"Do not forget that you are the King's messenger," said the great Sargon (sär′gŏn), king of the Sumerians (sû-mēr′ĭ-*ă*nz), in the land later called Babylonia. "Be faithful to him even unto death!"

It was in the year 2700 B.C., and King Sargon was sending Kalki (käl′kē) with a letter to the governor of a province many miles away. Kalki was the swiftest runner of the kingdom, but more than that, he could be trusted. Here and there along the way he would rest and eat, but he would not sleep. His hand and his eyes would guard the king's letter until he placed it in the hands of the governor.

For hundreds of years in ancient times, all mail was carried by faithful runners like Kalki. As the years went by, the strongest kings of ancient times conquered the weaker ones and governed their lands. When the kingdoms grew larger, the rulers had to send messages to even the very farthest parts of their countries. The distances then grew too long for runners alone, and horses and camels were used to help carry the mail.

By 500 B.C. Darius (d*ȧ*-rī′*ŭ*s), the king of Persia, had a very well organized postal system all over his large kingdom. His counselors had worked out an excellent relay system along the principal roads of the



EUROPE and NEIGHBORING LANDS

Limits of the Roman Empire at the time of its greatest extent.

Scale of Miles
0 100 200 300 400 500

kingdom. Mounted couriers carried the mail. At certain places along the way, the courier stopped at an inn, or posthouse, as it was called, to change his steed. After he had ridden a certain distance, he passed the mail to the next courier, who carried it farther along the way.

Herodotus (hė-rŏd′ō-tŭs), a Greek who visited Persia, wrote a description of the Persian postal system. Today we may read, in English, a part of that description on the main Post Office building of New York City. It says: "Neither snow, nor rain, nor heat, nor gloom of night stays these couriers from the swift completion of their appointed rounds." We may be sure that the mail of the Persian kings was carried carefully and as quickly as the couriers could travel.

Egypt and Greece also had relay mail services. But the very best mail service of ancient times was found in the Roman Empire. It was called the *Cursus Publicus*. The Roman Empire was very large, and in all parts of it Roman officers and soldiers lived. A great many messages had to be sent back and forth between Rome and every other part of the empire. The postal service was very important. Good roads were needed to carry so much mail, and the Roman government built five great mail routes which started in Rome and ran to the farthest parts of the empire.

When Rome was conquered by the Teutons, the good Roman roads were neglected and the postal system was destroyed. With bad roads and danger on every side, people could not be sure that messages would be delivered; and they stopped sending messages by mail. For five hundred years very little mail was carried. Then, about the year 1200, people began to send mail again. Most of the mail at that time was carried on foot, for traveling was still very difficult. A courier usually wore a leather jacket, rough trousers, and high boots, and carried a strong, pointed staff. With the staff he fought off robbers and wolves, waded streams and mudholes in the bad roads, and climbed mountains.

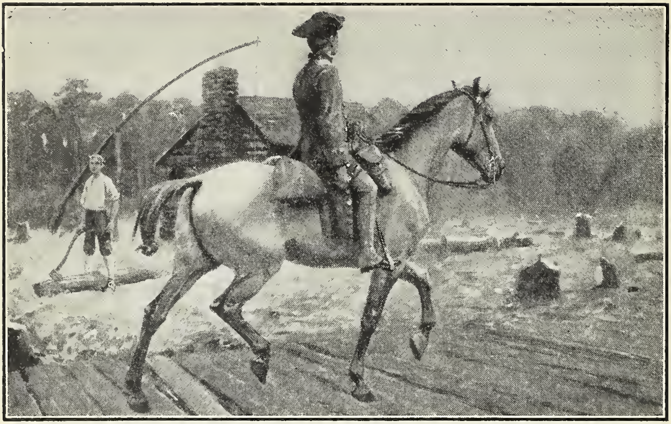
Toward the end of the Middle Ages, private postal routes were started. The peddler who carried his wares on the back of his mule also carried mail. Merchants carried mail in their ships and on their overland routes. The merchants of Venice (vĕn′ĭs) carried much mail along with their goods. In 1290 an Italian family named Tasso began to carry mail between Italy and Austria. Soon members of the Tasso family were carrying mail in many of the countries of Europe. The private mail service which the Tasso family started lasted for more than five hundred years, much longer than any other private service.

One by one, the nations of Europe started public mail routes. Poland started a regular courier service in the year 1458 to Rome and to other Italian cities. Spain, France, Sweden, and England all started government postal systems. For many years the private lines and the government lines both carried mail. But as the years went by, laws were passed forbidding private mail routes. Finally, all the mail service of Europe was managed by the governments.

For many centuries in every country, the mail service was used only by the government and by the very wealthiest people. It was so expensive to send mail that common people never could afford to write letters. Finally, in 1636, Sweden started a cheap mail service planned not only for the government and the wealthy people but for all the common people of Sweden as well. Cheap mail service spread from Sweden to the German cities, then to France, and then to England. Steadily, year after year, it grew easier for the people of Europe to exchange goods and ideas by mail.

For many years the early white settlers in America found it difficult to send letters to one another or to their friends in Europe. At that time the governments of the colonies did not manage the mails. The captains of ships or travelers carried letters and packages for their friends. To send mail overland, from one part of the country to another, was not easy. The roads were very bad, and hostile Indians made traveling dangerous.

When Francis Lovelace became governor of New York in 1668, he found it very troublesome not to have a regular mail service. He decided that the government should start a regular mail service. On January 1, 1673, Governor Lovelace sent out the first



An Early Colonial Mail Carrier, on a corduroy road.

overland postal messenger on the route between New York and Boston.

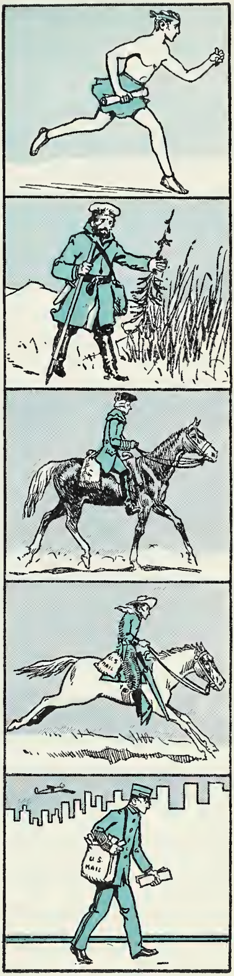
The first postman sent out by Lovelace rode on horseback and carried several little leather bags filled with mail. Through the woods and over the streams he went, following first this trail and then that. He stopped at taverns along the way to refresh himself and care for his horse.

Other colonies followed Lovelace's example and soon there were several government mail routes in the colonies. But carrying mail in the colonies was slow business until Benjamin Franklin became the postmaster general. A postmaster general is a man who has charge of the postal service of a whole country. Franklin had charge of the postal system in all the

English colonies south of Canada. In the summer of 1753, Franklin visited nearly every post office in the colonies. After that long journey, he was able to plan shorter and better routes and could decide how long it should take a rider to go from one stop to another.

Franklin expected the riders to go much faster than they had been going. Also, he planned to have more riders and more horses in the postal service. When he began his work, it took eight weeks to send a letter from Philadelphia to Boston, a distance of less than 300 miles. Before long, Franklin had cut the time down to one week. He managed, too, to lower the cost of sending letters. And he started regular mail service by boat between England and America.

Many thrilling stories can be told about carrying the mail in



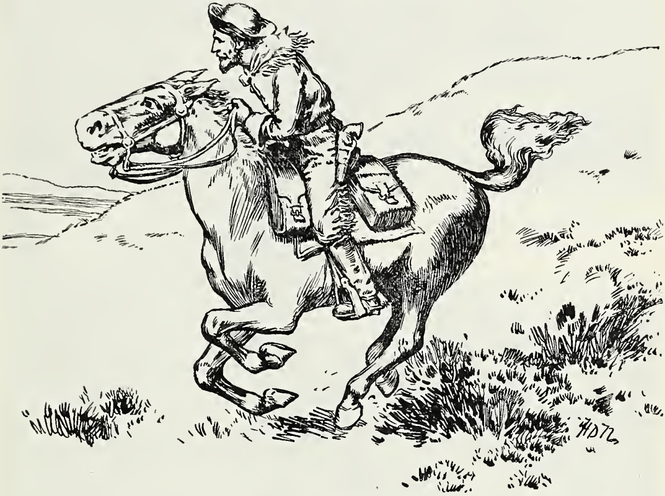
The pictures on this page show several mail carriers of long ago, and one of today. Can you describe the work each one did?

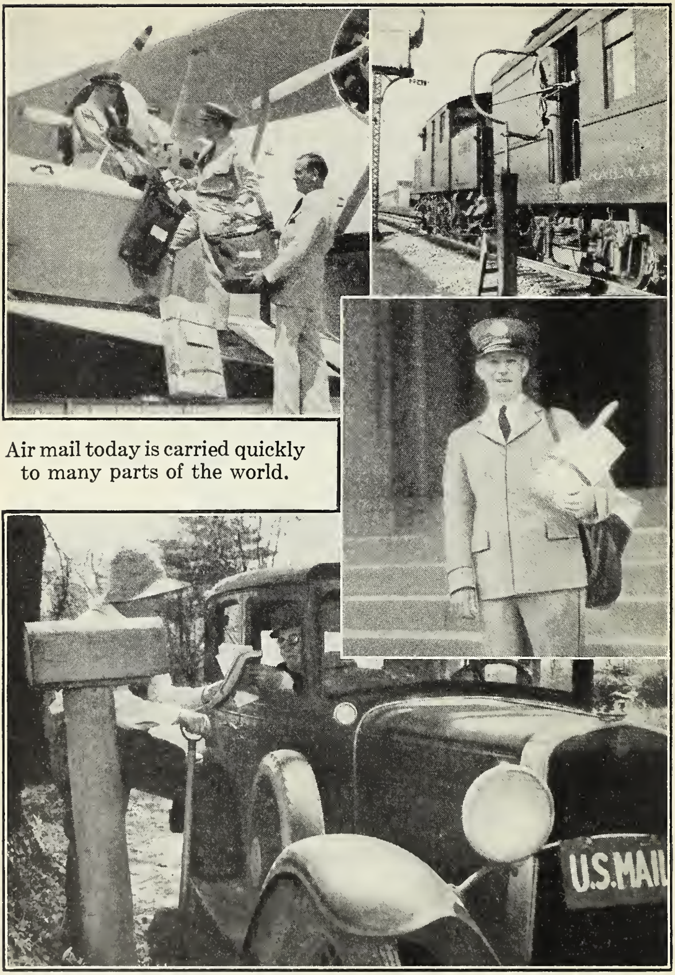
America. For years the mail was carried on foot, by postriders, or by coaches. Often the "foot post" was a trustworthy Indian who knew the shortest trails between villages. But the roads were bad, and savage Indians and white robbers lay in wait for travelers. The men who carried the mail in those days had to be as brave as the king's runners of ancient times.

In colonial times most of the settlers lived along the Atlantic coast, but many of them moved west beyond the mountains. In time, farms and villages and cities were started all over the West. Although it was growing easier for the people of the East to get their mail, postal service to the West was still poor. Little by little, however, better roads were built, and finally, long after the Revolution, canals were dug and railroads were started. Then the people of the East and West could get their mail regularly.

Have you ever heard of Buffalo Bill? His story is one of the thrilling ones which are told about how the mail was once carried in the Far West. It took a long time for the railroads to be built west of the Mississippi River. For years the people of California had no good and regular mail service. Finally, a Pony Express service was started and was kept going for about two years before the first telegraph line was built across the country to California. The Pony Express ran from St. Louis to California and was made up of fast riders who changed their ponies at posthouses along the way. Indians and robbers often attacked the Pony Express riders. But in spite of all of the difficulties the riders had to face, they were expected to deliver the mail on time.

Buffalo Bill, whose real name was William Cody, was the most famous Pony Express rider. When he was only sixteen years old he broke the record of all the other riders. Once when he had traveled 85 miles and was ready to hand the mail to the next rider and turn back along his route, he learned that the next rider had been killed by robbers. But the mail must not be late! So Buffalo Bill rode the next lap of the journey as fast as he could. On that trip he stopped only once to eat, and other times just long enough to


A PONY EXPRESS RIDER



Air mail today is carried quickly to many parts of the world.

Ewing Galloway

Trains, automobiles, airplanes, and postmen carry mail for the United States government.

change horses. Before he returned, he had done two men's work and had gone over 150 miles.

How many improvements have been made in the mail service of the United States! Today, the cost of sending mail is very small. Rural Delivery serves the people of country districts. Money orders can be sent safely by mail. Parcels can be sent by Parcel Post. For greater safety, every letter or package may be insured or registered. In cities, the postman delivers the mail right at the door, and collection boxes for letters and packages are placed short distances apart. Fast trains, trucks, steamships, and airplanes carry the mail today.

Just as the mail service of the United States improved, so the mail service of other nations improved. In 1874 the Universal Postal Union was formed, to which all the countries of the world belong. The Universal Postal Union makes it possible to send letters to any country of the world.

For many centuries men have exchanged goods and ideas by mail. For a very long time carrying the mail was slow, dangerous, and expensive. Then only kings and wealthy people could afford postal service. Today, mail is carried swiftly, safely, and cheaply. Because postal service is fast and safe and very cheap, nearly everyone uses it. In the United States alone more than 1,000,000,000 postal cards and more than 20,000,000,000 other pieces of mail are carried by the postal service each year.

Acting Time

Divide your class into groups and act out the ways mail was carried (*a*) in ancient Persia; (*b*) in the Roman Empire; (*c*) in the early Middle Ages; in the late Middle Ages; (*d*) in Franklin's time; (*e*) by the Pony Express; (*f*) in the United States today (you will want several scenes for this).

Do You Collect Stamps?

If you do, bring your stamp collection to school and find stamps which show different ways of carrying mail.

A Class Visit

Can your class visit the post office nearest you to see how mail is handled today?

Committee Work

Appoint a committee to find out the distances between the following places and how long it takes for a letter to go from one to the other today. How might letters be carried

(*a*) from Los Angeles to Washington?
(*b*) from Chicago to London, England?
(*c*) from New Orleans to Peiping, China?
(*d*) from Hamburg, Germany, to New York?

See if you can get from the post office a map of mail routes of the United States. Put it on your Bulletin Board.

8

Things We Write With

"How would you like to find out about the things we write with?" asked Miss Abbott one day. The boys and girls in her class had liked the stories of how men have learned to write and send mail.

"I suppose you mean that we'd find out about paper and ink and pens and pencils," said Enid.

Miss Abbott nodded. Then Joe spoke up, saying, "I think such things as printing presses and typewriters also belong in the story of the things we write with."

The class decided to begin at once to look for stories about the things we use when we write. Here are some of the stories they found.

PAPER

The first material people had to write on were the things they saw about them—the walls of their caves, flat stones, pieces of wood or of bark. Later, in the Tigris-Euphrates (tī′grĭs-ū-frā′tēz) Valley, people made clay tablets to write on. But the Egyptians learned to make the best material to write on that was known to the men of ancient times—papyrus (pȧ-pī′rŭs).

The papyrus reed grew in the muddy land of the Nile delta. The Egyptians learned to press thin strips

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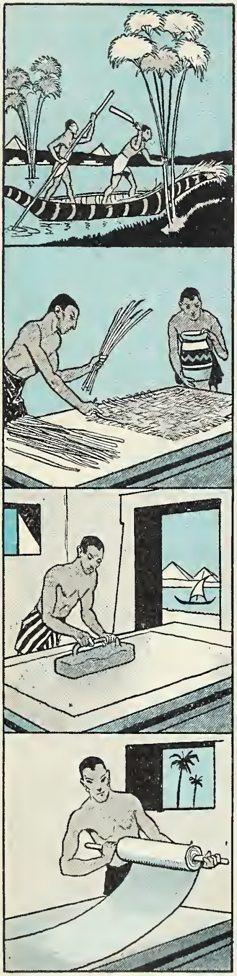
OF ALBERTA

of the papyrus plant into large thin sheets on which they could write. To make books, the sheets of papyrus were rolled into scrolls. The Egyptians wrote on papyrus as we write on paper. In fact, our word "paper" comes from the Latin word *papyrus,* which was taken from the Greek and Egyptian names for the papyrus reed. Papyrus was so useful that the other peoples of ancient times began to use it. Boats going from the Nile Valley to the other countries around the Mediterranean carried papyrus as well as grain for trade. Much of the writing of the Greeks and Romans was done on papyrus.

The story is told that a ruler of Egypt and a ruler of Pergamum (pûr′gȧ-mŭm) once went to war against each other. The Egyptians refused to sell any papyrus to the people of Pergamum. The

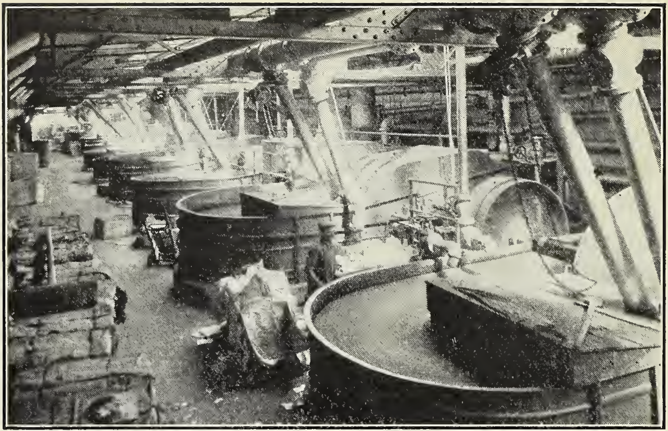


It was hard work to make papyrus. These pictures show Egyptians cutting papyrus plants, laying the strips across one another, pressing them together, and rolling up the finished writing material.

king of Pergamum asked his workers to find out whether the skins of animals could be used to write on. The workers in Pergamum experimented and finally found out that thin sheets of skin could be used to write on. From the name of their city their material was called *parchment,* and to this day we remember Pergamum in the word "parchment." During late Roman times parchment became an important writing material. During the Middle Ages most books were written on parchment. Manuscripts and records written on papyrus were kept in long rolls. Parchment was cut in sheets or pages which were sewed together in books much like those we have today.

While the people of ancient times and the Middle Ages were writing on papyrus and parchment, far to the east, in China, men were writing on still another kind of material. The Chinese had learned how to soak and grind the fibers of plants into a pulp which they pressed into paper. It is said that the Mohammedans captured some Chinese paper makers and from them learned how to make paper. The Mohammedan Arabs made paper from the fiber of flax and from linen rags.

From the Mohammedans who lived in Spain the people in Italy learned to make paper. By the thirteenth century the Italians were making a great deal of paper. Later on, the people farther north in Europe also began to make paper. Today our paper is made mostly in large factories with the help of machines.



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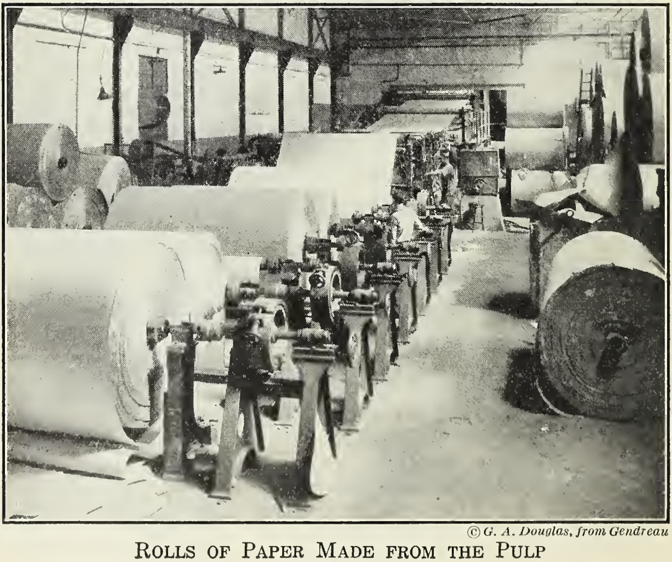
PULP IN A MODERN PAPER MILL



©G. A. Douglas, from Gendreau

ROLLS OF PAPER MADE FROM THE PULP

The hundreds of miles of paper that go to make our newspapers, magazines, and books are made from the ground pulp of trees. The best paper we have is made from flax and linen rags.

When you think of all the books and magazines and papers we have, aren't you glad men learned to make good, cheap paper?

INK

Papyrus, parchment, and paper would be of little use if men had not learned how to make ink with which to do their writing. The early Egyptians and the early Chinese made a mixture of powdered charcoal or soot and glue which they used for writing. The Chinese dipped a fine brush into this ink and carefully made their idea-signs with brush and ink. Today artists and architects often use "India" ink, which is very much like the ink used for hundreds of years by the Chinese.

The Romans made ink from a liquid which they got from the ugly shellfish that we call the *squid.* In the twelfth century the people of Europe began to make better ink from the tannin found in oak trees in Asia Minor. Tannin in the oak trees is really made by a little insect called the *gall-fly,* which lays her eggs in the soft twigs of the oak tree. Much ink even today is made of tannin mixed with liquids. The ink used in printing books and newspapers is usually a heavy, sticky liquid made of linseed oil and soot.

For many centuries writers mixed their own inks and followed recipes which they carefully saved. Today most of us use ink made in factories.

PENS

The ancient Egyptians wrote on their sheets of papyrus with pens made of split reeds. For writing that was not to be saved, the Greeks and Romans often wrote on wax tablets which could be scraped and used again and again. They used a pointed bone or metal tool called a *stylus* to write on their wax tablets. Late in the Middle Ages, when people began to use paper, they found that split-reed pens did not write very well on paper, and of course they could not use a stylus. They made pens from the quills of geese. Quills had to be carefully pointed and slit before they made good pens. The schoolmasters of colonial days in our own country had to spend much of their time making quill pens. Thomas Jefferson wrote the "Declaration of Independence" with a quill pen such as you see in the picture on page 35.

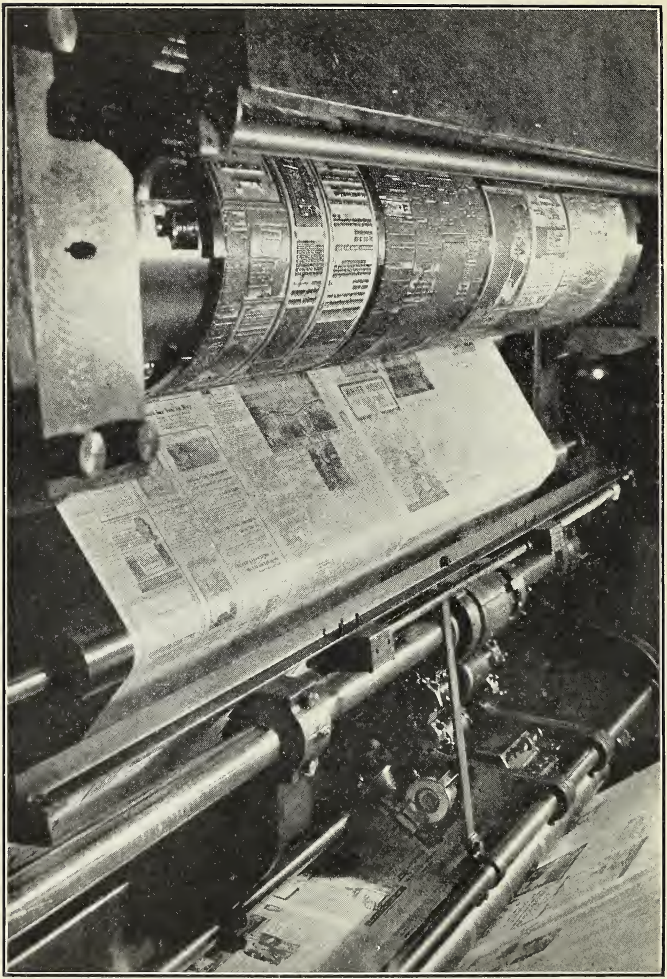
The steel pen that we use every day is really very young in the history of things we write with. In 1780 a locksmith living in Birmingham (bûr′mĭng-*ȧ*m), England, made a steel pen point by hand. He put the steel pen point on a wooden penholder. Later, when men learned to make pens by machines, pens became so cheap that everyone could afford to use them. The most important pen-making place in the world is still Birmingham, England, but the United States manufactures more than 300,000,000 pen points every year. Besides all the steel pen points, there are thousands of fountain pens made each year to help in the work of writing.

PENCILS

Often we do not write with pen and ink but instead reach for our cheap and handy pencil. Men very early learned to make marks with pieces of colored clay and soft stone. In ancient times men discovered that they could make marks with lead, and for a long, long time lead was used for quick and easy writing.

Late in the sixteenth century the English discovered that they had a mineral, graphite, which made better marks than lead. They ground up the graphite and pressed it into solid blocks. From the blocks they cut tiny bars and put them into wooden cases. This made what we call a *pencil.* Later they found that if they mixed a little clay with the graphite, they could make even better pencils. Even though our pencils of today are made of graphite and clay, we still call them "lead" pencils because men used lead for marking and writing for so long a time.

Today the mixing, shaping, and baking of the "leads" for pencils is done by machinery. Machines place the leads in their wooden cases, stain the wood, and fasten on the erasers to make the pencils we use.



Ewing Galloway

PART OF A MODERN NEWSPAPER PRINTING PRESS. You see here the curved plates and a sheet printed from them.

Printing Press

Men made paper and ink and pens so that they could communicate over time and space, but if they were to spread news and ideas quickly and cheaply, they had to make still another invention. Someone had to learn how to make many copies of a paper or a book quickly and cheaply. In the Middle Ages, when all books were copied by hand, only the wealthy could own so costly a thing as a book. There were no newspapers or magazines then. But men were already trying to make more than one copy of a page at a time by printing instead of writing. They carved letters or pictures on a block of wood. When they smeared the block with ink they could "print" from it many sheets, one after another. They were able to print several pages at a time from a single large block; but the blocks were hard to make and did not last long.

About the end of the fourteenth century there was born in the Rhine Valley a boy who was named Johannes Gutenberg (yō-hän′nĕs go͞o′tĕn-bĕrᴋ). When he was a young man, he and other men cut tiny blocks of wood into single letters which could be arranged in rows of words and sentences. They were held tightly together in a rack or frame and from them books were printed. The invention of printing with little movable carved letters was very important, but Gutenberg was not yet satisfied. The little wooden blocks wore out very quickly.

Then Gutenberg had another idea. For many years he worked trying to make the letters out of metal instead of wood. Finally he was able to make metal letters which did not wear out quickly. Then he had the idea of putting the frame of letters in a machine that could be used for pressing the pages of paper against it. His "printing press" was made. Gutenberg's invention of movable metal type and a "printing press" is one of the most important inventions in all history. The first printing presses that were brought to America by the colonists were very much like the one that Gutenberg had made about two hundred years earlier.

If Gutenberg could visit our printing plants today, how surprised he would be! He would find giant presses printing thousands of newspapers an hour. Do you wonder that the printing press ranks with the four or five most important inventions in the history of the world? Don't you think Gutenberg and others who worked to make our printing presses should rank high among the men who have helped to make our ways of living?

TYPEWRITER

Another invention which helps to make our ways of living today is the typewriter. For a long time men thought about making a machine that would write. On both sides of the Atlantic they experimented with the making of "writing machines," but the man who deserves the title of "father of the typewriter" is Christopher Latham Sholes, of Milwaukee, Wisconsin. In 1867 Sholes finished his first typewriter, but what an awkward machine it was! The keys were arranged in two rows and wrote only in capital letters. Sholes soon found out that his machine was not strong enough for daily use. He sold it to a manufacturing company, and the skilled workers of the company made the writing machine better and stronger. Since then many workers have helped to make the typewriter a speedy and strong machine for writing letters and making records.

The typewriter is very important in the work of the world. If letters and bills and business records all had to be copied by hand, as they were for hundreds and hundreds of years, business could not be carried on so quickly and easily as it is today. Today in our large offices we have many machines that help to keep records and write letters, but the typewriter is the "grandfather" of them all.

* * * *

Don't you think the story of the things we write with is almost as interesting as the story of writing itself?

Making a Visit

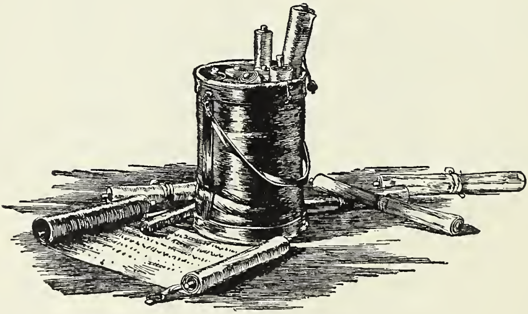
If there is a paper mill, a printing press, or a pen or pencil factory in your community, ask your teacher to take you to visit it.

Making a Scroll and a Seal

Make a scroll out of white drawing paper. Make your own ink and pen. Then with these write a summary of "Things We Write With."

Make a seal by cutting your initials on a cork stopper. Dip it in ink and stamp your summary.

Put the best scrolls and pen in your class museum.



Roman Scrolls

9

Communicating over Time and Space

Our cavemen ancestors learned to draw pictures of some of their ideas. People of very ancient times made picture writing simpler, and the Phoenicians found a group of twenty-two signs which could stand for the sounds in their language. While the people of ancient times were learning to use the alphabet they were also inventing tools with which to write. We now use pens and pencils instead of the simple stylus and reed pen of ancient times. Many inventors have worked to give us quick printing presses and useful typewriters.

For a long, long time men kept their important writing and records on costly papyrus and parchment. Today we have many kinds of good, cheap paper for all kinds of writing, and plenty of paper for books and newspapers. Postal service carries our written words all over the world.

After men had a simple alphabet and things to write with, they could write quickly and easily. Ideas could be sent from place to place and remembered as long as the writing lasted. Think how important writing is in our way of living today!

Name four things you are able to do which you could not do if you could not write.

Testing Game

See if you can match the items in Column 1 with the correct ideas in Column 2. Write the correct eight lines in your notebook.

Column 1	Column 2
1. Phoenicians	(*a*) made paper from pulp
2. Gutenberg	(*b*) carried mail in the West
3. Primitive men	(*c*) invented the printing press
4. Chinese	(*d*) wrote an English dictionary
5. Pony Express	(*e*) invented the first typewriter
6. Egyptians	(*f*) learned to talk
7. Noah Webster	(*g*) used the first alphabet
8. C. L. Sholes	(*h*) used picture writing

Reading Time

Probably you have had a library card for a long time. If you do not already have a library card, plan to go to the library soon and sign up for one, for you will want to read many books about our ways of living in the machine age. These books tell many fascinating stories of the ways men have learned to communicate with one another.

Books That Tell about Language and Writing:

Arnold, Emma J., *Stories of Ancient Peoples.*

Bush, Maybelle G., and Waddell, John S., *How We Have Conquered Distance.*

Clodd, Edward, *Story of the Alphabet.*

Hayes, Elizabeth L., *The Tongues of Man.*

Lansing, Marion F., *Man's Long Climb.*

Lipman, Michael, *Pictures for the King,* and *Letters for the King.* These books tell the story of the alphabet.
Unit Study Books, No. 409: *Communication.*

Stories about Books and Newspapers:

Hazam, L. J., *Extra! Extra! The Story of the Newspaper.*
Ilin, M., *Black on White; The Story of Books.*
Maxwell, Marjorie, *The Story of Books Up Through the Ages.*
Stein, Evaleen, *Gabriel and the Hour Book.* (Tells how a boy of the Middle Ages helped copy a book.)
Unit Study Books, No. 609: *Newspapers.*

Books That Tell Stories about Carrying the Mail:

Carpenter, Frances, *Ourselves and Our City.*
Crump, Irving, *The Boys' Book of the U. S. Mails.*
Theiss, Lewis E., *Piloting the United States Air Mail.*
Walden, Arthur T., *Harness and Pack.*
Walker, Joseph, *How They Carried the Mail.*

Talking Time

In the books you have been reading you have found many interesting stories. Pick out the one you like best to tell to the class. Think it out carefully so that it will not take more than three or four minutes to tell. Be sure to tell the class the name of the story and the book in which you read it. Here are a few stories some members of the class may wish to read and tell to the class.

In the story of "Talking Time" on pages 10–15 of this book you read how Enid and Carl and their mother and father thought language started. In Lansing's *Man's Long Climb,* pages 138–139, and Bush and Waddell's *How We Have Conquered Distance,* pages 157–167, you can find stories that tell about the beginnings and growth of language.

For stories of writing and the alphabet, see Lansing's *Man's Long Climb,* pages 139–144, and Bush and Waddell's *How We Have Conquered Distance,* pages 179–188.

For stories of the different ways people kept records before the invention of printing presses, see Bush and Waddell's *How We Have Conquered Distance,* pages 188–200.

In *Ourselves and Our City,* on pages 160–186, Frances Carpenter tells many stories about carrying the mail. On pages 217–232 of *How We Have Conquered Distance,* Bush and Waddell tell more stories about mail and its importance in our ways of living.

Here are some places where you can find stories of the invention and the great work of the printing press. If you have other books of inventions, look in the Table of Contents and the Index for "printing press" and "Gutenberg."

Bachman, Frank P., *Great Inventors and Their Inventions,* pages 187–207.

Bush and Waddell, *How We Have Conquered Distance,* pages 201–214.

"The Book," pages 203–221 of S. E. Forman's *Stories of Useful Inventions,* is a good account of the ways men have preserved their thoughts from very earliest times to now.

10

Smoke Signals and Tom-toms

The boys and girls of Miss Abbott's class were having a picnic—a signal picnic. At school they had been reading of the ways in which signals were used long ago to communicate over distances, and Dick had sighed, "I wish we could try out some of those signals." To everybody's delight, Miss Abbott had replied, "We can. We'll have a picnic and every one of you can illustrate some way of signaling across space."

Now here they were on Picnic Hill, and the time for signaling had come. The boys and girls began with signals made by sound, for Miss Abbott had explained that the first signaling was limited to short distances. In the beginning, men could signal by sound only as far as the human voice would carry. It was not till later that instruments like bells and drums were used, but even then signals could be sent only as far as the human ear could hear.

Among the sound signals made by members of the class were blasts on horns, to represent the trumpets of the Middle Ages. Then there were signals made with drums, such as the tom-toms of the Indians. The drums used by primitive people were made by stretching a piece of skin over a section of a hollow tree. Thumpings which Allan made on his brother's drum sounded just as thrilling as a real Indian tom-tom. There were signals with whistles, too. Dick even imitated the hooting of an owl, as trappers sometimes do to signal to one another in the forest.

Signals that could be seen, however, were much more numerous than the sound signals. Men learned very early that it is often easier to see than to hear. If the wind happened to be blowing in the wrong direction, it carried the sound away from the one who was trying to hear it. Or if thunder was crashing or crowds were shouting, the signal sound was lost in the louder noise. But by means of signals that could be seen, it was possible to signal over greater distances.

The members of the class tried out some of the sight signals. Hope and Marion had puzzled everybody with the queer bundle they had carried all the way up the hill. Now they proudly unwrapped two cardboard shields to represent those used centuries ago by knights in battle. A knight's shield, besides protecting him, told who he was, where he came from, and what lord he served. Since the shields could be seen at a distance, they served as signals to tell who was coming.

Jim and Carl used flags for their signal stunt and explained how flags have been used ever since ancient times. They are still used by ships at sea and by scouts in wigwagging. The boys told also how square-rigged ships often used to send messages by letting a sail fall a certain number of times.

"If I had a horse," said Jack, "I could signal as the Indians used to, by the position of my horse. The Indians often signaled that way. They sent messages with mirrors, too, when they could get them. I do not know just how this was done, except that the sunlight was flashed in certain ways."

All this time Harvey had been eagerly awaiting his turn. When Miss Abbott finally nodded to him, he sprang up on the bare rock and very carefully built a small fire of green wood that smoked a great deal. Then, while all the class watched closely, he held an old blanket over the fire so that the smoke could not rise. When he took it away, the smoke rolled up again, and as he kept moving the blanket back and forth, he made the smoke rise in separate puffs that could be seen for a long distance. "The Indians

Here are several old-fashioned ways of signaling. Tell what each person is doing to communicate with someone else.

used to signal that way," Harvey explained. "They signaled so much that whenever an Indian saw a straight column of smoke with never any puffs in it, he knew it was a white trapper's fire and not an Indian's."

Harvey signals with smoke, as the Indians used to do.
How can puffs of smoke be used as signals?

"They were not the only ones who signaled with smoke," added Miss Abbott. "Back in Roman days the barbarians from the north used smoke signals that the Roman guards could see beyond their walls but could not understand. Signaling by smoke is a very ancient custom."

There was one type of signaling that the class could not show because it was daylight—signaling by lights.

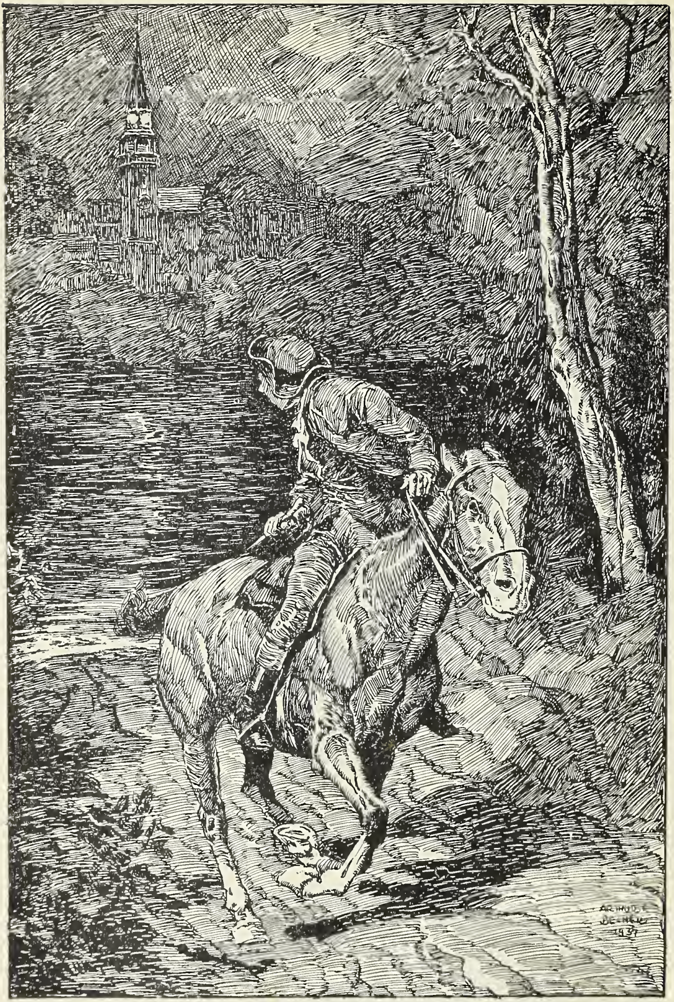
This was a kind of signaling that became popular very early. A light shows clearly in the darkness and helps men to signal over even greater distances than is possible with either sound or daytime signaling by sight. Signals with blazing torches were common in ancient Greece. Beacon fires called England to arms in 1588 when the Spanish ships sailed up the English Channel to attack her. In Scotland flaming crosses were kindled on the hilltops when the clansmen went to war. And of course everyone is familiar with modern signal lights—the lights of lighthouses that warn ships of dangerous shoals and rocks, and traffic lights in our cities and on railway lines.

When the signal picnic was over, every member of the class felt that he understood a little better how important it is and always has been to be able to send messages across space. The class saw how it is possible to make people see signals farther than they can hear them. But they also saw that even the best signaling is slow and often difficult to understand.

Tell the class about the ways of signaling that are described in the *Boy Scout Handbook.*

Acting Time

Ask your teacher if you may divide your class into groups and act out this story. Be sure to show all the important ideas in signaling.



The Beginning of Paul Revere's Famous Ride

11

Messages by Wire

One night in the year 1775 a man, booted and spurred, stood beside his horse in the shadow of a thicket on the bank of a river. Though the night was still, the horse seemed to feel that danger was near. The man, nervously stroking his horse's neck, kept his gaze fastened on a spot in Boston on the other side of the river. Suddenly from out of the darkness a light gleamed. The man grasped the reins and sprang into the saddle.

"The British are coming!" said the man under his breath, "but how? *One lantern,* I said, if they come by land, and *two* if they come by sea. Ah! There is the second! By sea!" he cried, and he started his horse at a mad gallop on the road.

We have all heard of the midnight ride of Paul Revere. He rode from Charlestown to Concord (kŏng′-kẽrd), Massachusetts, warning people along the way that the British soldiers were coming. On the next day the battle of Lexington was fought. That battle was the beginning of the American Revolutionary War. On July 4, 1776, the American colonies declared their independence of Great Britain.

In 1876 a World's Fair was held in Philadelphia in celebration of the one hundredth anniversary of the

Declaration of Independence. In a corner of one of the fair buildings a man sat with a queer machine which he hoped people would look at. For a long time, however, no one noticed him. Then suddenly the man heard his name called.

"Mr. Bell! I am so glad to see you again!" It was the Emperor of Brazil, Dom Pedro, who was greeting the man with the queer machine. The Emperor of Brazil was interested in all the exhibits at the fair. Many people followed him as he walked from booth to booth.

When Dom Pedro greeted Mr. Bell he turned to the people with him and said, "I admire Mr. Bell very much. He helped me greatly when I was planning a school for the deaf people of my country."

Then he turned to Mr. Bell and asked, "What kind of machine do you have here?"

"This is a talking machine. I call it a *telephone.* I made up the word 'telephone' from two Greek words which mean 'far sound.' If your Highness will take the receiver, I will show you that this machine does just what its name says. It carries the sound far."

The emperor took the receiver and put it to his ear just as Mr. Bell had directed. By this time, a great crowd of people had gathered around the booth. When everything was ready, Mr. Bell went to the other end of the long room and spoke into the mouthpiece of the telephone there.

"It talks!" cried the emperor, in great amazement. Although Mr. Bell and the emperor were some distance apart, Mr. Bell did not have to shout his message. The wire seemed to carry the sound of his voice.

THE FIRST TELEPHONE, as it was shown to Dom Pedro by its inventor, Alexander Graham Bell, in 1876.

One after another, the people with the emperor tried the queer machine. Sure enough, they could hear distinctly everything that was said. Then Mr. Bell's telephone became the most popular exhibit at the fair.

Who was Mr. Bell?

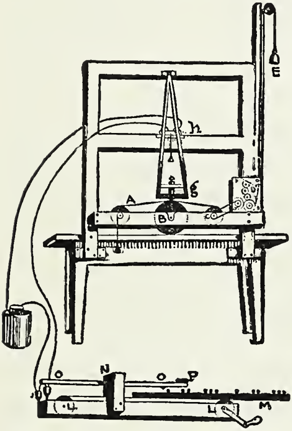
Alexander Graham Bell was born in Scotland, in the year 1847. In 1870 he came to live in America and made his home in Boston. At first, he was a teacher of deaf people. Later he taught at Boston

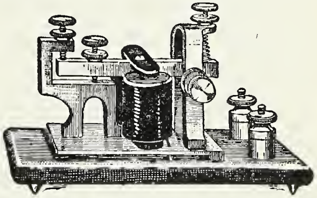
University. He was always interested in people who could not hear, and did everything he could to help them. While he was working on instruments for the use of people hard of hearing, he invented the telephone.

Long before Mr. Bell was born, scientists had learned that signals can be sent through copper wire by the use of electricity. They called this method of signaling the *telegraph,* a word which was made from two Greek words meaning "far writing." It is called "far writing" because the signals sent over the wire stand for the letters of the alphabet and for numbers. By 1836 more than sixty different systems of telegraphy had been invented, but none of them worked very well.

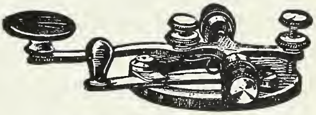
In the year 1832 Samuel F. B. Morse, an American artist, was returning from Europe. Morse was interested in science as well as in painting. While in Europe, he had heard about the experiments in telegraphing made by English and German scientists. During the long journey across the Atlantic, he thought of a new system of telegraphy. But Morse was poor and did not have the time, instruments, or money to carry out his plans. Finally, two friends came to his aid. They gave him money and instruments and even worked with him in his laboratory. Together, by 1838 they had completed the telegraph which Morse had planned on his way home from Europe. It was the first successful telegraph.

Many telegraph experiments failed because the inventor could not make practical instruments to receive the message. For his telegraph, Morse worked out an easy system of dots and dashes for the letters of the alphabet and the numerals. This is called the Morse *code* and it is still in use today. The receiving instrument on Morse's first telegraph had to write only dots and dashes on a moving tape. Every time a dot or a dash was written the receiver clicked.





In the first telegraph receiver, at the left, a pencil (at g) made dots and dashes on a moving tape (A). The later receiver, above, made only clicks.



MORSE'S FIRST TELEGRAPH SYSTEM

MORSE'S LATER TELEGRAPH SYSTEM

In each system the sending instrument is shown below, and the receiver above. (The two instruments of the later system are connected by the long wires of an electric circuit that is not shown in the diagram.)

Morse soon learned that the clicks could be read as easily as the dots and dashes on the tape. Therefore he improved the receiver so that it would make the sounds perfectly, and called it the *sounder*. Since then telegraph operators have read most of the messages by listening to the sounder. Morse's telegraph might not have been so successful if Morse had not worked out his code. The Morse code is almost as important an invention as the telegraph itself.

A	·–	H	····	O	· ·	U	··–
B	–···	I	··	P	·····	V	···–
C	·· ·	J	–·–·	Q	··–·	W	·––
D	–··	K	–·–	R	· ··	X	·–··
E	·	L	——	S	···	Y	·· ··
F	·–·	M	––	T	–	Z	··· ·
G	––·	N	–·				

THE MORSE CODE for the twenty-six letters.

To prove that the telegraph could be useful, Morse wanted to lay a long telegraph line. To do so would cost more money than his friends could afford, so Morse asked the government of the United States to help him. Year after year went by, while the government paid no attention to him. Just as he was about to give up the idea of a telegraph line and go back to painting pictures, the government granted his request.

In 1844 Morse and his friends were able to lay the first telegraph line between Washington, D. C., and Baltimore, Maryland. Soon other lines were built, for people saw how helpful Morse's invention could be. By means of the telegraph, messages can be sent very quickly over long distances.

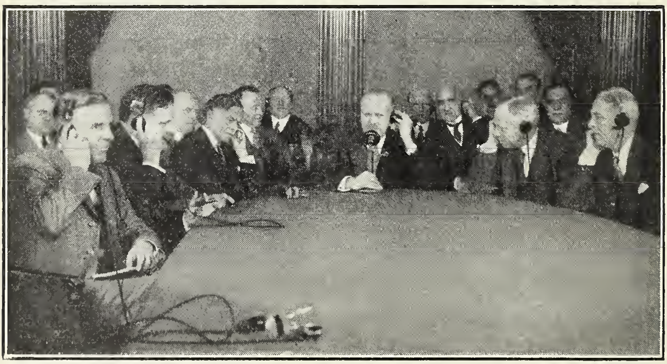
By 1861 scientists had learned that sounds made at one place could be reproduced at another place by the power of electricity sent over copper wire. Using the knowledge gained from others, Bell was able to invent a machine which makes sounds exactly like the human voice at the other end of the wire. This machine was the telephone which he exhibited at the World's Fair in 1876.

The first telephone line was stretched between Cambridge (kām′brĭj) and Boston, Massachusetts, a distance of only two miles. Even so short a distance proved how valuable a telephone could be. Businessmen soon saw how much time a telephone saves, and many of them had telephones put in their offices. In a short time the telephone became very popular.

Soon other inventions made it possible for men to talk with each other over very long distances. Then long-distance telephone service was started and cities were connected with one another. Soon it was possible to telephone from Boston to San Francisco, a distance of 3,500 miles. Finally, in 1926, just fifty years after Dom Pedro had seen Mr. Bell's talking machine, England and the United States were connected by telephone.

A recent improvement in sending messages by wire is the teletype, or teletypewriter. Two of these machines can be connected by a telegraph wire or a telephone wire of any length; and then what is typed on one machine will also be typed at once on the other. Thus long written messages can be sent and delivered very quickly.

Paul Revere had to depend on his eyes to see the messages signaled to him from the belfry of the Old North Church. He had to depend on his horse to carry him to Concord, and on his voice to carry the message which he shouted to the people along the way. Today, there are telephones in most of the homes along that way. In fact, thousands of miles of telephone wire stretch all over the United States and most of the other countries of the world. There are telegraph cables, too, in every country of the world and they even connect the continents with one another. If Paul Revere were living today, he would not need to depend on lights hung in a belfry. People traveling across the Great Plains today do not need



Wide World

Here you see how interested many men were in sending the first telephone message from New York to London, in 1926.

to depend for messages upon smoke signals. The inventions of the telegraph and telephone have put an end to "smoke signals and tom-toms."

Make a List

Make a list of all the new words in this story.

Acting Time

Act out a play called "Mr. Bell at the World's Fair."

Writing Work

Write a summary of this story.

Write your name in the Morse Code. Put it in your notebook.

Write a paragraph showing how the telephone and telegraph help the newspapers to give us the latest news.

Talking Time

What important events happened in 1838 and 1876?

Can you tell any true stories to prove that the telephone has helped people in times of danger?

What is the difference between a telephone and a speaking tube? Between telephone and telegraph?

12

On the Air

Miss Abbott's class was in the assembly hall with all the other classes in the school, listening to the radio. They were hearing the President of the United States speak. As his voice was heard in the assembly hall many of the pupils knew what he looked like and how he acted as he sat at his desk many hundreds of miles away from them. Indeed, some of them, in a "children's hour," had themselves taken part in broadcasting.

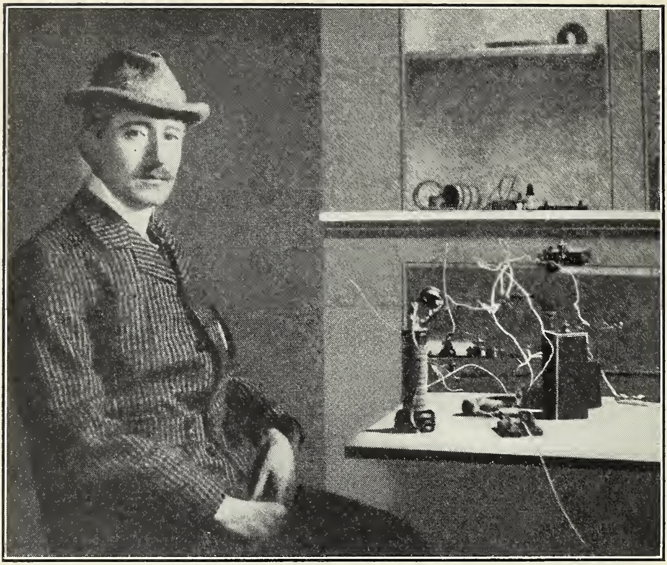
When Miss Abbott's class returned to their room, they talked for a time about the radio. When a nationwide hookup is announced, the program can be heard by people all the way from the Atlantic to the Pacific. We can also hear broadcasts from European countries and can send those countries our programs. When the stations are once set up, the radio provides a quick and easy way of sending and receiving messages. The invention of the radio is another important step in the history of communication.

We are so used to hearing radio programs today that we seldom stop to think what has made it possible for millions of listeners to hear a voice from a studio hundreds of miles away. Like so many of our machines and other conveniences, the radio has come

Paramount

This picture shows Admiral Byrd broadcasting from his camp in Antarctica, in 1934. His broadcasts were heard in the United States, many thousands of miles away.

to us from the patient labor of many men whose experiments and discoveries have added to our knowledge of electricity. In 1888 a German named Hertz discovered that when he made an electric spark in a jar he could get another spark at the ends of a wire coil without having any wire connecting the jar and the coil. He could get the sparks in the wire coil even when it was on the other side of the room from the jar. What Hertz did was to send electric waves across the room from the jar to the coil. When the



MARCONI AND HIS FIRST INSTRUMENT for sending wireless messages.

electric wave reached the coil or wire, it made a spark there. This was the beginning of wireless telegraphy.

The next step toward our radio was taken by a young Italian, Guglielmo Marconi (g͞ool-yĕl′mō̇ mär-kō′nē̇). He believed that if sparks in one place could make sparks in another place, messages might be sent in this way. After much hard work and study, he made some small machines that would send electric waves across a table and would repeat the signals he made. Then he improved his machines so that he could send his wireless signals across his garden.

Marconi tried to persuade the Italian government to help him develop his wireless telegraph, but the officials were not interested enough to help him. He then went to England, where he was given help. He set up a station on the English coast and succeeded in sending messages to ships a few miles out at sea. Each year he was able to send his signals farther and farther. He sent them across the English Channel. Among the vessels that had Marconi's wireless outfit was a lightship anchored near the coast of Norway. During a severe storm the lightship broke loose from its anchor and was drifting helplessly at sea in great danger of being wrecked. The lightship used Marconi's invention to send out signals of distress which were picked up by other, larger ships. These ships came to the rescue of the lightship and saved the drifting vessel and its crew. Then it was that more people saw how valuable Marconi's invention might be.

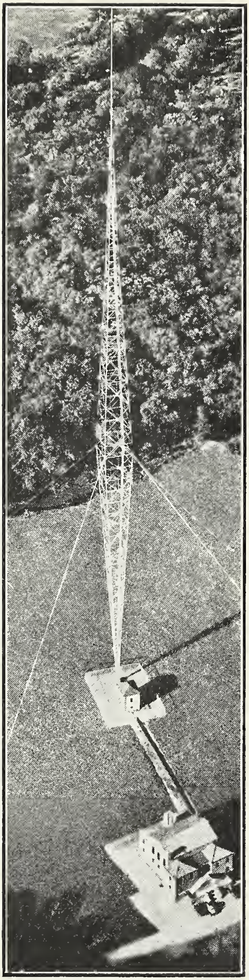
In 1901 Marconi set up a receiving station in Newfoundland (nū-f*ŭ*nd-lănd′). He tried to catch the electric waves which he hoped would bring signals from England. He sent up one kite after another, each lifting a wire connected with his receiving set; but several such kites were wrecked in the wind. He sent up a small balloon, but it broke loose and sailed away. At last he sent a strong kite four hundred feet up in the air. Then he heard the signals from his station in England coming across the Atlantic Ocean.

In the years that followed, the wireless telegraph was greatly improved and was spread all over the world. Many ships and lives have been saved because of this new kind of communication. The signals sent and received were always sharp sounds, either long or short. What Marconi did was to invent a wireless telegraph which sent messages the same way that Morse's telegraph had sent them with wires in 1844.

Scientists continued to experiment more and more with the wireless way of sending and receiving messages. One of the important stepping stones toward our radio was the bulb Edison invented for the electric lamp. From experiments with these bulbs, an American inventor, Lee DeForest, developed the radio vacuum tube. When the tube was used in a wireless outfit, spoken words and music could be sent from one station to another. This method was much better than sending only the Morse code with sounds. The powerful broadcasting stations have tubes as tall as you are. Your radio set at home has several tubes which make the loud speaker do its work to entertain you. DeForest is the Alexander Graham Bell of wireless telephoning.

Because of these many years of study and experimenting, you can turn a knob today and listen to your favorite programs. You can hear the Christmas and New Year's celebrations in many American and European cities. You can hear the speeches of famous people. You can follow baseball and football games play by play. You can hear the news of events happening in all parts of the world. Explorers such as Admiral Byrd can keep in touch with the world during their long trips thousands of miles from their homelands.

Even with all these wonderful things accomplished with the radio, scientists are still experimenting, trying to improve the broadcasting stations and the receiving sets. Perhaps the most interesting development is sending pictures by wireless, or "television" as it is called. It is now possible, with the necessary special instruments, to see the face of the person with whom you are talking by telephone. But these instruments are expensive and are not in common use. Probably in future years we



The picture shows a great broadcasting station, as seen from an airplane. Notice how small the large building looks. The steel tower, from which the radio waves are sent out, is 625 feet high.

shall be able to see football games and plays in the theater thrown on the television screen in our own homes, just as we now listen to the radio. Television is another step in the long and thrilling story of communication.

Talking Time

Some of you may imagine you are Hertz, Marconi, and DeForest. Tell the class what you gave to the radio.

Others may imagine you are: (1) a ship captain, (2) a person who likes music, (3) Admiral Byrd, (4) a boy who likes baseball, (5) a housekeeper, (6) a shut-in, (7) an airplane pilot. Tell how the radio has helped you or given you entertainment.

A Class Exhibit

Perhaps some of the class members can bring their small radio sets to school and explain to the class how they work.

For Investigation

Make a list of the ways our government uses the radio.

See how many different stations you can get on your radio at home tonight. How many different kinds of programs can you get? Write a brief description of your favorite program.

13

Exchanging Ideas

Far back in primitive times people learned to use language. The story of communication began in that long-ago age when people first began to speak with one another. The story of communication has gone on ever since then, affecting the ways of living of all the people in all parts of the earth.

Long after men first learned to speak, they learned to write. Then people could exchange information and ideas even when they were far apart. And people could read books about what men of earlier times had said and done. Today we can read letters and newspapers from all over the world. And we can read what was written by the ancient Greeks and Romans and all the other people who knew how to write.

In the years that have passed since men began to read and write, many inventions have been made to help communication. Pen, paper, ink, the printing press, the typewriter, telegraphs, telephones, and radios —all these are important in our ways of living because they make it easier to exchange information and ideas.

Do you think you could live even for one month without communicating with anyone? Probably not, for communication is one of the most important parts of our ways of living.

Making a Communication Time Line

Make a time line and put on it the most important inventions in the history of communication.

An Assembly Program

Give a broadcast in the Assembly Hall, telling the story of communication. Some of the characters can be the different kinds of signals, materials, machines, etc., mentioned in this unit: picture writing, letters, words, languages; records, books, newspapers, etc.; letter, telegram, radiogram, cablegram. The stories in this unit will help you to plan your program.

Things to Think About

1. Have you ever thought how important your school is in helping communication? Tell the ways the school helps you to communicate well with others. What does the school do to help you find out what people in other times and other places have thought and done?
2. What is the most important invention in the history of communication?

Reading Time

You know that the library contains many of the records of the things men have done. Have you ever thought how the library arranges its books so that they can be used easily?

In the card catalogue you can find a record of all the books in the library. In fact, you will usually find at least two cards in the catalogue for each book. One card will be under the name of the author, and another card will be under the name of the book. Sometimes there will be a card under the name of the subject too, such as "Travel" or "United States History," or whatever the topic is you are looking for. If you do not understand the system your public library uses for arranging its books, ask the librarian to explain it.

Here are some books in which you can find stories about the invention of the telegraph, the telephone, the radio, and other things that help us to communicate quickly and easily. Look in books about inventions for more stories.

Books That Tell Stories about Communication:

Bachman, Frank P., *Great Inventors and Their Inventions.*

Bush, M. G., and Waddell, J. F., *How We Have Conquered Distance.*

Carpenter, Frances, *The Ways We Travel.*

Forman, S. E., *Stories of Useful Inventions.*

Lambert, Mrs. Clara, *Talking Wires.*

Langdon-Davies, John, *Radio.*

Meriwether, Susan, *The Story of the Telephone and the Genie Called Electricity.*

Stone, G. L., and Fickett, M. G., *Famous Days in the Century of Invention.*

Van Loon, Hendrik Willem, *Man the Miracle Maker.*

Webster, Hanson Hart, *The World's Messengers.*

Talking Time

When your class talks about the inventions that have helped communication, bring some of the books from the library and show the pictures. Have you selected a story to tell?

On pages 222–241 of *Stories of Useful Inventions,* S. E. Forman tells the story of "The Message," from early times to the days of the wireless. Can you tell why Forman does not include the radio in his story?

For more stories about early ways of sending messages, see Carpenter, *The Ways We Travel,* pages 251–256, and Bush and Waddell, *How We Have Conquered Distance,* pages 169–178.

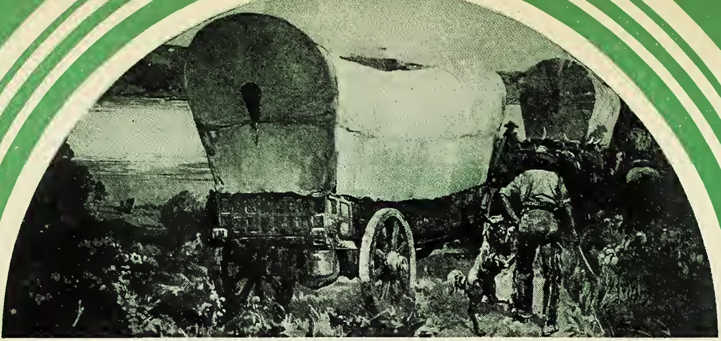
There are more stories about the telegraph on pages 208–227 of Bachman's *Great Inventors and Their Inventions,* pages 168–199 of Perry's *Four American Inventors,* pages 256–265 of Carpenter's *The Ways We Travel,* and pages 233–241 of Bush and Waddell's *How We Have Conquered Distance.*

For more stories about the telephone, see pages 228–246 of Bachman's *Great Inventors and Their Inventions,* and pages 266–278 of Carpenter's *The Ways We Travel,* and pages 255–263 of Bush and Waddell's *How We Have Conquered Distance.*

You can find more stories about the wireless and radio on pages 261–265 of Bachman's *Great Inventors and Their Inventions,* pages 279–291 of Carpenter's *The Ways We Travel,* and pages 241–244, 264–269 of Bush and Waddell's *How We Have Conquered Distance.*

UNIT II

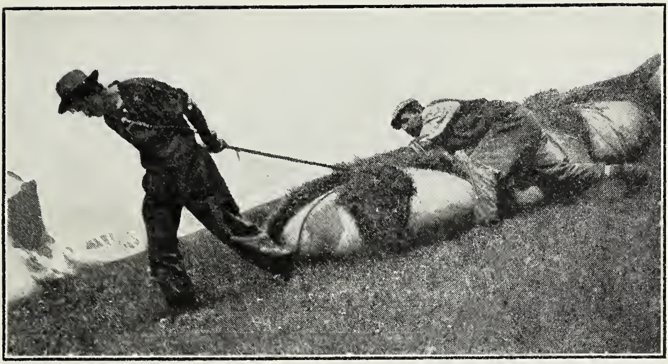
TRANSPORTATION



TWA
TWA

1

Carrying the Goods of the World



Albert Steiner, St. Moritz, Switzerland

HAULING HAY FROM A MOUNTAIN IN SWITZERLAND. In some parts of the world people still drag or carry the loads they need to move from one place to another.

One day, after the class members had finished reading about communication, Miss Abbott told them a story. Here is what she said:

* * * *

Long, long ago a primitive boy went hunting with his father. The two of them walked a long distance through the forest looking for game. Suddenly they saw a wild boar. Quietly they followed it. As the

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Credits: *First National Bank, St. Louis, Mo.; Stout Motor Car Corp.*

On the facing page you see one old, and three modern, means of transportation. In how many have you ridden?

When a primitive man killed a boar, how was he to take the big animal to his home?

boar walked into a narrow valley they climbed on the hillside above it. Just at the narrowest part of the valley the man threw a big stone at the boar. His aim was good. The stone struck the boar and killed it. Their hunt had been successful.

How good the boar meat would taste! The boy and his father were hungry, and they knew that the other members of their family at home were hungry, too. But how were they to get the boar home? At first they tried to carry it on a pole which rested on their shoulders, but they were soon tired. Then they tied strips of hide to the animal, and dragged it along over the ground. Hour after hour they worked, straining their muscles in order to pull the load home. When they finally reached their own campfire they were almost too tired to eat.

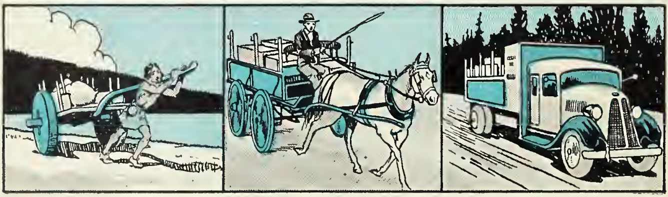
In early primitive times everything that was moved from place to place had to be moved by the work of human muscles. Water had to be carried from the stream or spring to the campfire. Animals killed in the hunt had to be dragged home through the forests. Early primitive tribes moving from place to place had to carry all their belongings on their backs.

As men's ways of living changed, however, they began to find new and easier ways of carrying goods from place to place. Early people learned to train animals to carry their heavy loads. The ox or the cow, the dog, and the horse became "beasts of burden." Then man did not have to work so hard.

Think how much animals carry for men today! In the United States alone there are about 12,000,000 horses which pull wagons and carts to carry goods for us. The Eskimos use dogs and the Lapps use reindeer to pull their sleds. In India the elephant lifts loads so heavy that several men together could not move them. In South America the llama is used to carry loads. All over the world animals have become burden bearers for men.

Besides training animals to carry burdens for them, men learned to make things that helped in the hard, heavy work of transporting goods. As you know, they learned to make wheels and wagons and boats. Think how these inventions help to carry things from place to place.

When men found easier ways of carrying things from place to place, they began to trade more and more. And as they traded, their ways of living became better. Think how surprised early people would be to see our freight trains, steamships, and automobile trucks carrying big loads. Think how much modern living depends on things brought from far away.



How useful the wheel is! One of its chief uses is in transportation.

As people traded more and more, trade routes were marked out. The Indians made trails along which they carried their belongings. The ancient Phoenicians followed trade routes all around the Mediterranean Sea. The Greeks had regular trade routes to Egypt and to Asia. In the Roman Empire good roads were built along the best trails by land, and the Roman ships followed regular routes on the sea. Along these land and water routes all the goods of the traders of ancient Rome were transported.

In the Middle Ages trade routes were not so good as in Roman times. Toward the end of the Middle Ages, however, the merchants of Venice and Genoa (jĕn′ō-*ȧ*) were marking out trade routes from the Italian cities to the East. Today there are trade routes over all the world. On these routes thousands of people help in the world's great task of carrying goods from one place to another.

Have you ever thought about these trade routes of the world? Or about the animals or boats or engines which transport goods along the routes? Or about how transportation helps to make your ways of living?

* * * *

When Miss Abbott had finished, the class wanted to know more about transportation. They wanted to know how ships were built, who invented locomotives and trains, where automobiles and airplanes came from. They wanted to know about trade routes across the oceans, about the railroad tracks that tie our country together, about automobile highways, and about the routes followed by airplanes.

On pages 101–188 are some of the stories the class read in order to find out more about transportation.

Using the Dictionary

Look in the dictionary to find out exactly what the words *wheel* and *transportation* mean.

Talking Time

Talk with your classmates about the different ways of traveling you know.

Picture Frieze

During your study of this unit you may wish to make a picture frieze of transportation for your classroom. Let it tell the story of the different ways of carrying goods used from primitive times to the present.

Making Things

As you read the stories in this unit make for your museum as many models as you can of the different kinds of transportation. You may begin by making models of early wheels and carts, and the raft, dugout, and birchbark canoe that were used in early times.

2

Ship Ahoy!

One hot August morning in the year 1807, Amos Collins sat in the stern of his father's fishing boat, sorting tackle. The little sailboat was tied to the wooden pier of a small fishing village on the Hudson River a few miles above New York. On shore Amos's father and uncle were mending nets.

Although Amos was only ten years old, he was already a good sailor. He liked to sail up and down the Hudson. He thought of the times his father had taken him to the harbor of New York. As he worked with the tackle, Amos remembered how that great harbor looked, filled with all kinds of sailing vessels. There were little fishing smacks like his father's, larger river boats, and ships that sailed the seven seas!

Suddenly Amos lifted his head and listened. What was that queer sound below the bend in the river? He saw smoke and sparks. Something must be on fire! A burning boat must be coming up the river, for the smoke and noise came nearer and nearer. Soon it rounded the bend. What a queer-looking object! It was not a sailboat and it was not really on fire! What could it be?

"Father!" shouted Amos, as he climbed up on the pier. Before he could tell what frightened him, his father and uncle and many of the village folk had gathered on the pier to watch the strange craft.

"I'm glad we are on shore instead of out in the river. I shouldn't want to be near that roaring monster!" exclaimed Amos's father.

"What can it be?" asked Amos.

"That must be the steamboat," replied the village school teacher. "The last time I was in New York I heard people talking about it. It was being built then."

"How can it move without sails or oars?" asked Amos.

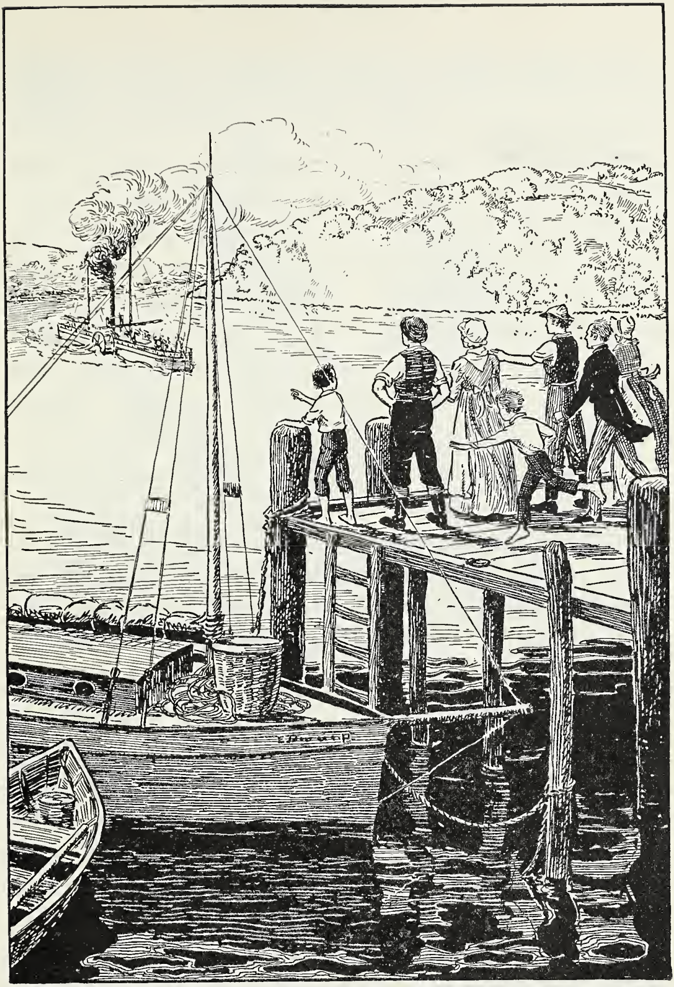
"Those large paddle wheels on the side take the place of sails," explained the teacher.

"What makes the paddle wheels go?" asked Amos, who was still puzzled.

"There is a boiler of water inside the ship," said the teacher. "The fire turns the water into steam, and the steam makes the paddles move."

As they spoke, the boat chugged steadily against the current. Soon it was out of sight up the river.

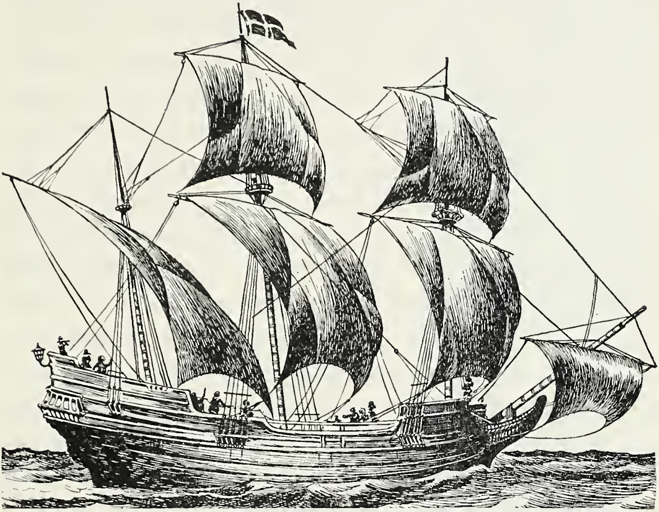
"You don't need to be afraid you will ever see that sight again, son," said his father. "She'll sink before she gets to Albany (ôl′bȧ-nĭ). The heavy steam engine she has to carry will sink her. I've heard about her. Robert Fulton, the man who made her, calls her the *Clermont*, but most seamen down in New York call her *Fulton's Folly*. And I'll say it's folly to think that anything can take the place of sails and oars!"



The Clermont, on its first trip up the Hudson River, was watched by many people.

Amos felt better when he heard his father speak, but he did not go back to his fishing tackle. In fact, very few who had seen the *Clermont* went back to work that day. Groups of people all up and down the Hudson River could be seen talking excitedly about the smoking monster. There were many different ideas about the steamboat that day. Some people thought there was an evil spirit, hidden inside the boat, that spouted forth the smoke and fire, and made the boat go by magic. Others did not believe in magic but had no faith in ships run by heavy steam engines. To them, nothing could take the place of sails and winds. Had not sailboats been used for hundreds, yes, thousands of years?

In primitive times man had first learned to travel on water by paddling dugouts and canoes. Then he learned to make sails for his crude boats, and the wind helped to push him along. About 3000 B.C. the ancient Egyptians were using sailboats on the Nile River. By 1000 B.C. the Phoenicians were sailing their trading vessels around the Mediterranean Sea. Later, Greek and Roman boats, using oars and sails, could be seen on the Mediterranean. You have seen pictures of the "long boats" of the Norsemen, and the beautiful sailing vessels of the merchants of Venice. Columbus crossed the Atlantic Ocean in 1492 in a sailboat. It was a sailing ship, the *Mayflower*, that brought the Pilgrims to America in 1620. Almost two hundred years later, when the *Clermont* first steamed up the Hudson River, sailing ships were carrying on trade all over the world.



THE MAYFLOWER

In spite of the prophecy made by Amos's father, the *Clermont* did get to Albany, going one hundred fifty miles in just thirty-two hours. The trip was so successful that the *Clermont* began to make regular trips, carrying passengers, between New York and Albany. Other steamships were built, to travel along the coast between Philadelphia and New York, and up and down the Great Lakes. In 1819 the steamship *Savannah* crossed the Atlantic from New York to Liverpool, in England, using a steam engine, as well as sails.

Fulton had not been the first man to experiment with steamboats. The Frenchman Jouffroy (zhōō-frwȧ′), the Scotchman Symington, and three Americans, Fitch, Rumsey, and Stevens, had all built steamships before Fulton. But the *Clermont* was the first steamboat to make successful voyages at a profit. Even after 1807, however, Fulton and other builders had many problems to solve before steamboats could become very useful. Experiments on the rivers, lakes, and ocean proved that steam engines were often too heavy for wooden vessels to carry. The coal and wood needed for the engines took up too much space. Then, too, the chugging of the engines shook the boats so hard that some of them did not last long. Many improvements had to be made before steam could take the place of sails. For many years after 1807 there was a contest between sails and steam to see which was better for water transportation.

While men were experimenting with steamships, builders were making great improvements in sailing vessels. For a long time England had held the record for shipbuilding, but about the time that the *Clermont* was built, American shipbuilders learned to improve their sailing vessels. They built ships with long, narrow prows and rigged with many sails. Because their sharp prows seemed to clip the waves as they sped over the water, the ships were called "clipper ships." Clipper ships carried tea from China, spices from the East Indies, silks and jewels from several parts of

Asia, and lumber, fur, tobacco, and cotton from North America. By 1850 the American clipper ships were the fastest on the oceans and were visiting every great port of the world.

In 1838 the *Sirius* and the *Great Western* crossed the ocean, using steam power alone. The *Great Western* made a speed of over two hundred miles a day. It took the fastest clipper ships two weeks to make the trip from Liverpool to Boston, but by 1888 the "ocean greyhounds," as the steamers were called, could make the trip in six days. Gradually steam won the contest against sails.

At first all ships were made of wood. Then some were made of iron. About fifty years ago shipbuilders began to make ships of steel. Steel ships are stronger and safer than wooden or iron ones.

The pictures show Fitch's steamboat, driven by paddles; Fulton's *Clermont* and two later ships driven by paddle wheels; and a wooden steamship driven by propellers under water at the stern.

About 1855 an invention called the "screw propeller" was made to take the place of the paddle wheels. The screw propeller, shaped much like the airplane propellers we see so often now, pushes the ships along faster and helps to keep them from rocking. Today, most of the large vessels have "stabilizers" which take away nearly all of the rocking and make traveling on the ocean very smooth.

Today, steamships have replaced sailboats for most of the travel and trade on water routes. The largest ocean liners travel between America and England in a little more than four days. What would Amos Collins say if he could sail on one of today's fast ships? What would he think of the comfortable staterooms, the dining rooms, the gymnasiums, the swimming pools, and decks as large as a hotel roof? He would be interested to learn that every modern ship has radio and wireless telegraph. His eyes would bulge in surprise if someone told him how many millions of tons of cargo freight steamers carry to and from all the ports of the world each year.

After a trip on one of the modern steamships, Amos Collins would admit that steam has taken the place of sails. Although many sailing vessels were better than the first steamship, yet the *Clermont* was the beginning of the fast water transportation of today. Without steamships traveling on the rivers and lakes and oceans of the world, our ways of living could not be what they are today.

Bulletin Board

Find pictures of Robert Fulton and the ship *Clermont* for your Bulletin Board. Bring to class, if you can, pictures of the ships described in the story. Be sure to include pictures of a Yankee clipper and a great ocean liner. Get some pictures and charts from steamship companies of today.

A Time Line

Make a ship time line, using the dates and events given in the story.

For Your Notebook

In your notebook paste pictures of ships, showing how they have changed since ancient times. Make a list of the most important steps in the story of water transportation since primitive times.

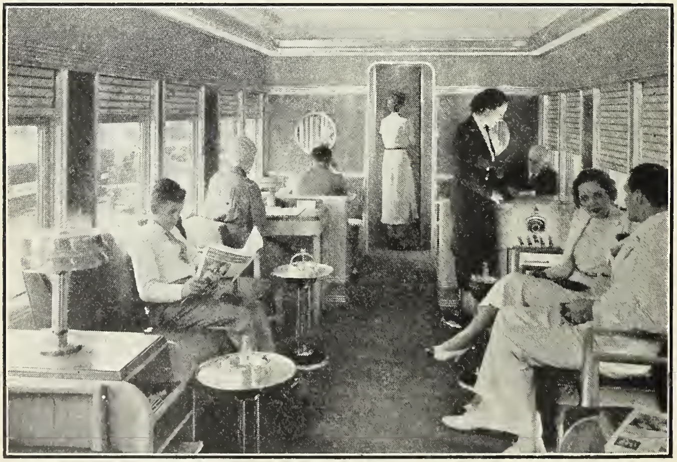
For Your Museum

Make a sailboat and a model of a steamboat to add to your collection. If you have ever been on a great ocean liner or a sailboat, tell the class about your experiences.

Acting Time

Write and give a play called "Amos Sees the *Clermont*."

A STREAMLINED TRAIN crossing the Great Salt Lake in Utah.



Fairbanks

In a CLUB CAR, or DRAWING ROOM CAR, on a streamlined train.

3

A Trip on the Imagination Flier

We are going to take a trip today on a very strange train. It is called "The Imagination Flier." That is a good name for the train, because all of us are going to imagine that we are traveling backward through the years. The Imagination Flier is going to take us back into the history of all the trains in the world.

Imagine that we are seated on one of the new streamlined aluminum trains of today. Our smooth leather seats are comfortable. We admire the bright, clean-looking furnishings inside the car, the large windows, the ventilators, the electric reading lights, and the overhead lighting. Everything about the train is arranged to make our journey a pleasant one.

The train starts so easily that we scarcely feel it getting under way. The powerful oil-burning engine gains speed rapidly. It runs as smoothly as a new automobile on a level road. This train can go as fast as 100 miles an hour, but on regular runs it does not go much faster than 70 miles an hour.

We pass many other passenger and freight trains that are traveling less rapidly than we are. In the freight trains we catch glimpses of coal cars, cattle cars, closed cars, and open platform cars. We see many refrigerator cars, and tank cars filled with oil.

Everywhere trains are carrying people and goods quickly from place to place.

The first stop we make on our journey is at a station named 1934. There we notice some passengers leaving our train. Then a very strange thing happens. Our streamlined aluminum train has changed. Our train now does not look so new. The men who got off the Imagination Flier at Station 1934 were the inventors of the streamlined trains and the light aluminum parts for building them. We must continue our journey backward in history without them and their wonderful inventions. We shall stop at several "stations" representing the years when other inventions were made. Some of the inventions were not widely used on railroads, however, until a few years later.

At Station 1920 we see several passengers get off. They are the inventors of the oil-burning locomotive. Our train is not so clean now. Everything is covered with soot. When we rub our fingers on the seat or the window sill we get black marks on them.

As we hear the conductor call "Station 1890," several more passengers walk down the aisle to the door. These are the men who developed steel cars. They get off the train, taking their inventions with them. We notice now that our car is made of wood, except the wheels and the under platform on which the car is built. Our car shakes a good deal, and the wood creaks as we ride along. The locomotives we see now have high smokestacks and long cowcatchers.

The other passengers left on the Imagination Flier look old-fashioned to us. We do not see so many different kinds of freight cars as we ride along. Most of them are smaller and made of wood.

When we stop at Station 1887, Mr. Janney, the inventor of the automatic car coupler, steps off our train, and several trainmen climb on. We shall need these trainmen from now on to "couple" or join our cars by hand, and also to work the brakes. We travel much more slowly now and there is a great deal of delay when we have to change cars.

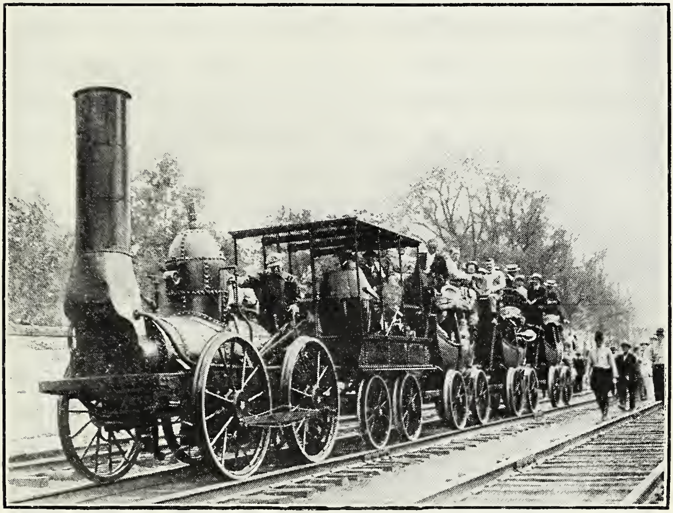
At Station 1869 an interesting-looking man leaves the train. He is George Westinghouse, the inventor of the air brake, which was used after 1888. To get to the old hand brakes, the brakemen, we see, run through the passenger cars and along the tops of the freight cars. It is not very pleasant riding now. The cars bump together when we stop, and we are jolted about in our seats. Our train can run only about half as fast as the streamlined aluminum train on which we started our journey.

When our train went around a curve we have sometimes seen the track ahead for a long distance. It was fun to watch the block signals move and to see the lights change color. White means a clear track, green means "go slowly," and red tells the engineer to stop. Now we see no more block signals, and their inventor, named Hall, leaves our train at Station 1867. Collisions will be much more frequent and traveling by railroad more dangerous now. We don't like the train at all by this time. The windows are smaller, and the seats are uncomfortable. Everything about the train is dirty with smoke and dust; there are no electric fans, and the cars are hot and stuffy. The electric lights disappeared from the train long before it reached Station 1878, when Edison invented them. Then as our train continued on its backward way, gas lights were replaced by kerosene lamps that smoke a good deal and give little light.

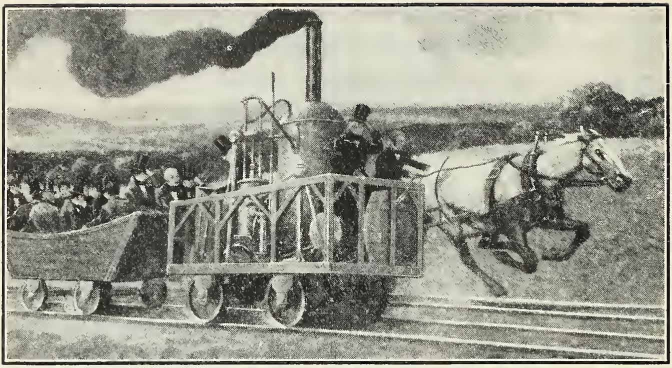
Our comfortable Pullman berths disappear before we reach Station 1864, when George Pullman leaves the train. At night, we have to sleep on a hard wooden bunk as best we can. We now find little that is comfortable about traveling by railroad. It seems almost a hardship to us. We notice that the locomotives are much smaller. Some of them burn wood, and they all make long stops.

Now we find that we are riding in a car like a freight car with square holes sawed in the sides. How the smoke and soot blow in, and sometimes glowing sparks, too! It seems strange to us to call such an old wagon a passenger car. The people have changed, too. They wear clothes like those in old pictures we have seen. The men have great long-tailed coats and stovepipe hats, and the women wear large skirts and strange bonnets. Their speech, too, sounds strange to us. They say "Sir" a great deal, and sometimes "thee" and "thou," and often "'tis" and "'twere." We hear long arguments about the locomotives and the trains. Some of the passengers talk about how much better the train is than other ways of travel. Some say that it is wicked to try to travel so fast.

After another change we find ourselves riding in a train of three stagecoaches mounted on little four-wheeled trucks, like handcars. We see its little engine, with a tender that carries, not coal, but only a barrel of wood and a barrel of water for the boiler. This locomotive is one of the first ever seen in the United States, and is named the *DeWitt Clinton.* It was first tried out on a railroad in central New York.



THE DEWITT CLINTON TRAIN, as seen on an exhibition run in 1921. It made its first trip in 1831.



Courtesy Baltimore & Ohio R. R.

This picture shows a race that really was made between the locomotive *Tom Thumb* and a horse in the year 1830. Many people then thought that horses were better than engines for hauling cars.

At Station 1830 we find ourselves riding on the Baltimore and Ohio Railroad behind a still stranger-looking locomotive called *Tom Thumb*. The few passengers are huddled in an open box set on four small wheels. We are having a race with a similar box on wheels drawn by a horse. At first the *Tom Thumb*, made by Peter Cooper, steams ahead of the horse, but a leather belt slips from one of the wheels of the locomotive, and the horse wins the race.

On several trial trips we are pulled by a horse treadmill car and by a sailboat on wheels. These schemes did not work very well and they were given up in favor of the steam locomotive.

The Imagination Flier has taken us all the way back to the beginnings of railroads in this country, in the year 1829. At that time, in England, George Stephenson had built his famous locomotive, the *Rocket,* which was successful on its trial trip with twenty-two cars filled with passengers and twelve loaded with coal. For a hundred years a few English coal mines had had clumsy steam engines pumping out water. In 1803 Richard Trevithick (trĕv'ĭ-thĭk) mounted a steam engine on a platform with wheels and was able to pull coal cars with it. We can call this the beginning of steam transportation on rails.

It was only a little over one hundred years ago that steam transportation on railroads was started. The wonderful passenger trains and freight cars of today are the gifts of many inventors, workers, and businessmen. They make it possible to carry vast numbers of people and millions of tons of goods from place to place by rail.

For Your Notebook

1. Make a list of the important steps in the development of trains from the first clumsy steam engine to the streamlined trains of today.
2. Make a list of ways in which trains are better for transportation than steamships are, and another list of ways in which steamships are more useful than trains.

For Your Transportation Frieze

Add the story of trains to your picture border.

A Time Line

Make a train time line, with pictures showing how trains have changed since 1800. Compare this with your ship time line.

The Parts of a Train

Let several pupils represent the different parts of a train and tell the class how they help to make better transportation. Consult the encyclopedias if you need more information. Different pupils can be:

A cylinder on a locomotive
A driving wheel
A rail in the track
A piece of coal
A gallon of water
An oil burner
A refrigerator car
A tank car
A dining car
A sleeping car
A block signal
An air brake

For the Bulletin Board

Collect pictures of trains. What kind of trains do you think are most interesting?

4

The Horseless Carriage

"It is impossible, I tell you. That man is crazy. He ought to be locked up." Thus spoke excitedly one of the crowd watching the Frenchman Cagnot (kän-yō′) make ready to try out his newly invented steam wagon.

Others in the crowd shook their heads doubtfully. "Of course it is impossible," one of them said. "A steam engine may pump water out of a coal mine in England, but that copper kettle hanging in front will never puff hard enough to move those heavy wheels and the big wooden wagon."

"Look there," cried another spectator, "four men have climbed on the wagon. They will never leave the spot."

To the people in that crowd on the streets of Paris in 1769, it did not seem possible that anything as small as the kettle boiler could move the great three-wheeled wagon with its four passengers. The Parisians had never seen steam do anything but escape from a tea kettle on the stove. They had never seen steam locked up, and did not dream of its great power. But on this day Nicholas Cagnot went to work and got up steam. As he climbed to his seat, the crowd stood silent. He pulled a lever. The steam began to hiss. A few jeers came from the crowd as nothing more happened.

Another pull at the lever. "See the wagon shake," exclaimed a spectator. "It moves, it moves!" shouted another.

Surprisingly enough, the great heavy wheels began to turn, and the world's first automobile was on its way. Jeers turned to cheers as the steam wagon kept going until it had traveled a little more than a quarter of a mile. Its speed was only 2¼ miles an hour, but it moved.

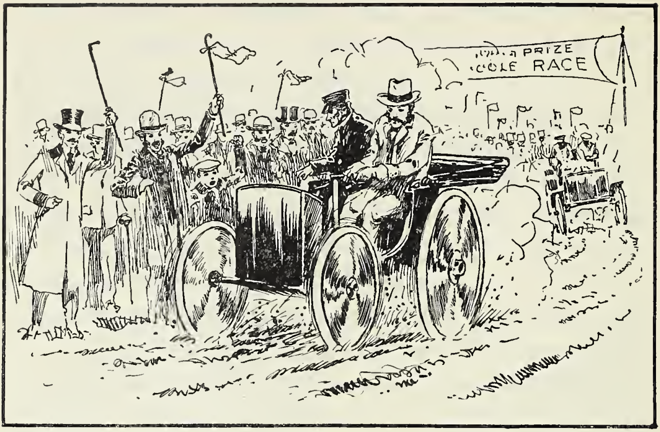
Years later, in 1827, a crowd of Englishmen watched the trial trip of a steam carriage invented by Goldsworthy Gurney. As in Paris, there were doubts and jeers, but Gurney's invention was a success. Two years later he built a steam carriage for eighteen passengers. It had a stagecoach body on four wheels and two smaller wheels in front. Strangest of all, it had two iron legs in front of the back wheels. These iron legs dug in the ground and gave the carriage one push after another to help the wheels along. Gurney's coach could travel ten miles an hour and could carry enough fuel and water to run for an hour. Again we must not think of our high speeds of today, but remember that ten miles an hour is over four times as fast as the speed of Cagnot's wagon.

Other inventors built still more steam carriages. During the same years, steam *railways* were being built, and their owners did not like to see the steam carriages and busses carrying passengers and goods over the country roads where there were no railroad tracks.

The farmers did not like the steam carriages, because the engines scared the cattle and sometimes set fire to the fields. So many people in England disliked the steam carriages that laws were passed forbidding them to travel faster than four miles an hour in the country and two miles an hour in the cities. Each steam wagon also had to pay a small sum, or toll, in order to use the roads. And a man had to walk in front of it with a red flag to warn people to get out of the way. All these rules put a stop for many years to the growth of the new way of transportation.

Although steam carriages were stopped in England, inventors in other parts of Europe and in America continued to try to make horseless carriages. The early steam wagons had to carry a heavy load of fuel and water. The heavy load kept them from carrying many goods or people. Finally in 1884 a German named Gottlieb Daimler (gŏt′lēb dīm′lẽr) invented a gasoline engine. The gasoline needed for that engine did not weigh nearly so much, or take up nearly so much room, as the water and coal or wood needed for a steam engine. At first Daimler made his gasoline engine run a bicycle. Then another inventor fastened the gasoline engine to a tricycle. Between 1892 and 1896 several American inventors built four-wheeled carriages driven by gasoline engines.

On Thanksgiving Day, 1895, a crowd of Americans gathered in Chicago to see the first automobile race in this country. Six cars started on a run of 70 miles,

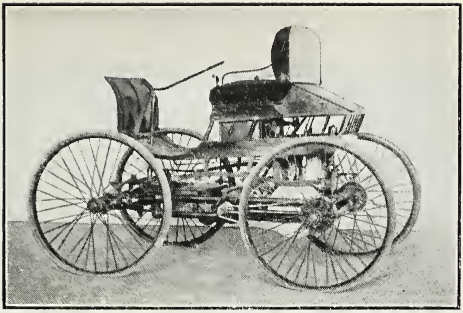


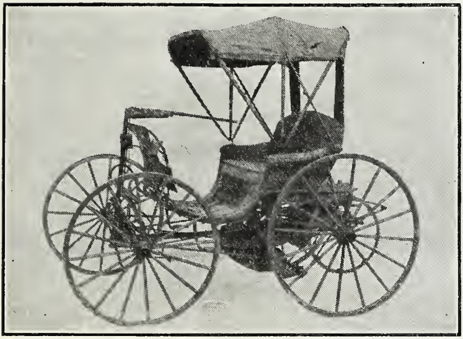
Near the end of a 70-mile automobile race in Chicago in 1895.

35 miles out of the city and back. After seven hours two cars returned, a Duryea (dōōr-yā′) and a foreign car. The others could not finish the race. The speed of ten miles an hour was the same as that made by Gurney's steam carriage in England sixty-eight years before. But the advantage of the gasoline engine was so clear that automobiles, like steamships and locomotives, had come to stay.

You have seen pictures of the horse and buggy of your grandfather's time. The first automobiles were truly horseless carriages. The inventors took horse-drawn carriages for their patterns. There was no windshield. People wore long coats called dusters to protect their clothes. Women tied their hats fast with scarfs and veils, as they sat on the open seats.

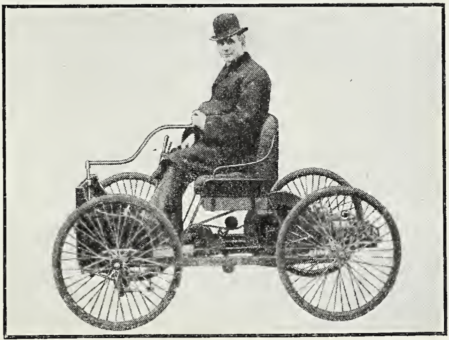
The early automobile made by Elwood Haynes; in the Smithsonian Institution in Washington, D. C.





The early automobile made by Charles Duryea, and called the "buggyant"; in the Smithsonian Institution.

The first automobile made by Henry Ford.



Brown Bros.

THREE OF THE OLDEST AUTOMOBILES IN AMERICA

Culver Service

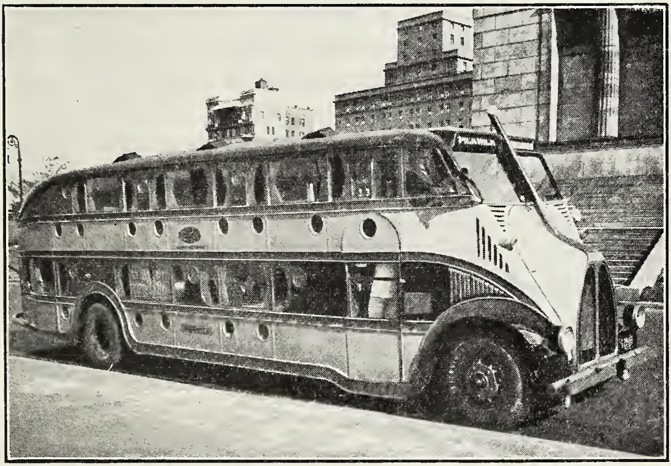
EARLY AUTOMOBILES. Notice the women's hats and veils.

Since the first jerky, one-cylinder cars, the manufacturers have made better cars year by year. We have four-cylinder cars and cars with six or eight or even twelve or sixteen cylinders. Today the engines are not only more powerful but also they are a smaller part of a car's weight and burn less gasoline per horsepower than those which were first made. The cars are easier to drive because improvements have been made in the gears and in all parts of the machinery. They are much better-looking, too. You can see the changes in the new cars which are sold each year.

Besides all the different cars for carrying people, we have many different kinds of automobile trucks for carrying goods.

You also see large passenger busses. On some busses you can read the names of cities that are a long way from your home. Passengers today can get aboard a bus in New York City on the Atlantic coast and ride to San Francisco on the Pacific coast. People and goods can be carried in busses where there are no railroad tracks.

If you will think over what you have read about automobiles in this story, you will see that they have helped to give us, in some ways, better transportation of goods and people.



Ewing Galloway

A Two-Decker Streamline Passenger Bus

Automobile Pictures

Collect pictures showing the history of automobiles. Arrange your pictures in order so that they make an automobile time line. You will want to make pictures of some of the automobiles for your Transportation Frieze.

For Your Notebook

In your notebook write on the left side of a page a list of ways in which an automobile is "better" than a train. On the right side write a list of the ways in which a train is "better" than an automobile.

Things to Think About

In what ways do you think the automobile makes our ways of living better than they were before?

What dangers does the automobile bring to our ways of living?

What kinds of work do many people do today that they did not do before the "horseless carriage" was invented?

Acting Time

Give a play called "Cagnot Tries Out His Steam Wagon."

Give another play on "How to Cross a Busy Street Safely!"

5

Balloons, Airplanes, and Dirigibles

Pierre (pyâr) and Henri (än-rē′) were helping their parents in a hayfield in France one day more than 150 years ago. "Why are all the people looking at the sky?" Pierre asked Henri, as they paused in their hay raking. The two boys saw that their parents and all the other peasants in the fields near by were gazing upward.

"What is it?" Henri asked. "I cannot see anything."

Now all the peasants were pointing and talking excitedly. The boys strained their eyes in the direction of the outstretched arms and saw a small round speck in the sky. It was moving.

"See, Henri!" said Pierre. "It is getting bigger."

"It is coming this way!" cried Henri.

Half afraid and half curious, the boys ran to their parents, who were near by. The grown people were more frightened than the children. They thought it might be some mysterious creature that would harm their poultry and cattle. They were angry as well as frightened.

Suddenly something seemed to happen to the object in the sky. It was no longer round; it was reaching down and getting long like a snake. "It is a dragon," some said. Others declared it was a flying serpent.

But whatever it was, it was coming straight down and right toward the peasants, who started to run in terror. With a whir through the air the "monster" struck the ground a short distance from the peasants. Then all was still.

After much argument as to what they should do, the peasants decided to make an attack on their strange visitor. Then if it was really a beast of prey, it could not pretend to be dead in the daytime and attack them or their animals at night. Armed with pitchforks and scythes, the peasants walked up near their "enemy."

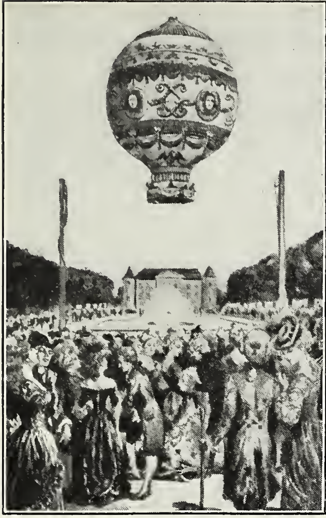
"The creature looks as if he were made of cloth and ropes," a peasant said.

"That may be just to deceive us," cautioned another. What they were looking at on the ground was a heap of silk and tangled rope netting.

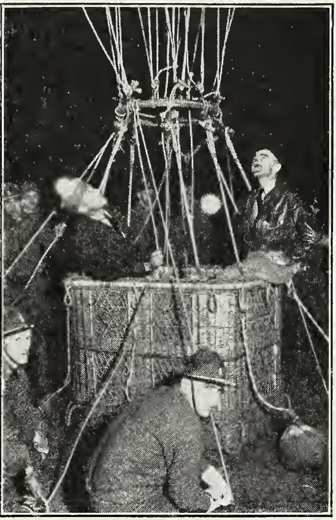
"The monster has escaped from a great fish net," suggested an old peasant.

"Do not go too near; its breath may be poison," some one warned.

A few of the younger men, more daring than the others, finally crept up to the object and hurled their pitchforks into it. When nothing happened, others struck it with their scythes. After several advances and retreats, the "creature" was torn to pieces. The ground was strewn with bits of silk, rope, and a few pieces of wood and metal. That was the end of the first flight of a hydrogen balloon.



THE MONTGOLFIER BALLOON, at Paris in 1783.



Fairbanks

THE BASKET OF A LARGE BALLOON of the U. S. Army Air Corps.

That same year, 1783, boys and girls in Paris saw many wonderful things happening with balloons. The Parisian boys and girls told one another excitedly about the large paper balloons made by two brothers named Montgolfier (mŏnt-gŏl′fĭ-ẽr, or môɴ-gôl-fyā′). The balloons were filled with hot air from a straw bonfire, and they stayed up until the air cooled. They were thirty feet in diameter, and even larger. The first "passengers" to ride in the small basket car of a balloon were a sheep, a duck, and a rooster. The animals were unharmed after a trip of eight minutes.

Then a man rode in another hot-air balloon which was held by a rope one hundred feet long. The man took up with him an iron pan in which he kept a straw bonfire burning to supply the balloon with hot air. After this experiment, the first free balloon flight was made by a man who landed safely in a field five miles away.

In Philadelphia, in that same year, 1783, a carpenter, James Wilcox, went up in a basket car with forty-seven small hydrogen balloons attached to it. He also took up some animals with him. After these early experiments, balloons were improved and longer flights were made.

You can easily guess, of course, that the story of balloons is only a small part of the interesting story of transportation by air. There are ever so many books about airplanes or "heavier-than-air" machines, as well as about balloons.

Men first tried to make artificial wings that would flap like a bird's. With such wings they managed to rise about fifty feet in the air and to fly a hundred yards. The idea of the airplane was suggested by the kite. Men were successful in flying large kites, called gliders. Then came the idea of putting gasoline engines on the gliders. In December, 1903, the brothers Orville Wright and Wilbur Wright, of Dayton, Ohio, made the first successful airplane flights over the sand hills near Kitty Hawk, North Carolina. Their plane traveled 852 feet in one minute. This was a great triumph at the time because it showed that a 200-pound machine with a passenger could be made to fly with its own power. In two years, the flight was extended to 24½ miles, while the machine was kept in the air for thirty-eight minutes.

These short flights and low speeds made the inventors eager to build better and faster airplanes. Factories and laboratories were built. Sums of money were given by governments and wealthy persons who were interested in the new way of travel. Expert mechanics and professors of mathematics worked many hours on very difficult problems. Scientists made careful studies of winds and air currents.

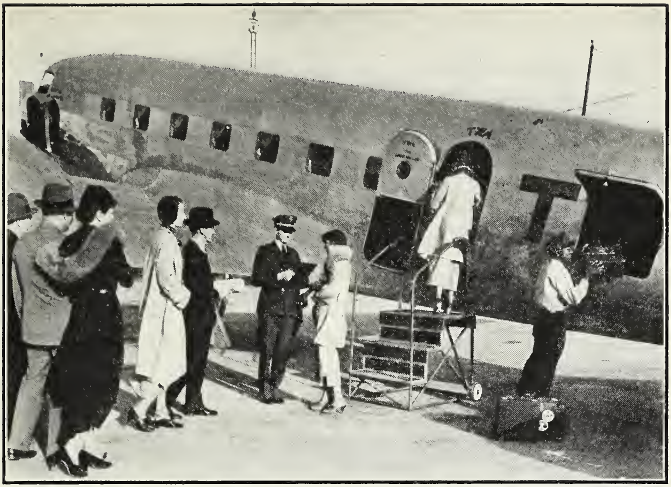
You know the results of all this work. You have read about

The pictures here show a glider made in 1890, a glider made and used by the Wright brothers in 1903, the Wright brothers' first airplane (1903), an early airplane made in France, and a modern airplane really very much larger than the others.

flights across oceans and continents, round-the-world flights, swift air-mail planes, huge passenger planes, nonstop flights of thousands of miles, and endurance flights of many days during which the plane is refueled in the air. In 1931 an aviator had breakfast in New York, flew to Havana for lunch, and back to New York for dinner. In 1935 the speed record was 415 miles an hour. In 1936 there were regular passenger planes traveling from New York to the Pacific coast in about sixteen hours.

Besides being wonderful machines, airplanes give us better ways of living. This is more important than breaking records of speed and endurance. Airplanes now carry people, mail, and goods faster than ever before. They do not need roads, or bridges across rivers, or tunnels through mountains. They fly high over cities, forests, mountains, lakes, and oceans.

Another important means of air travel is the dirigible. A dirigible is a large balloon that can be steered. It is an airship that is lighter than air. It is shaped like a cigar and has engines and propellers to drive it through the air. It will stay up in the air when the engines stop, because it is filled with gas. Dirigibles are very much larger and more expensive than airplanes. Because they are so large, they are more likely to be blown off their courses than are airplanes. They can carry more fuel than airplanes and can make longer journeys without landing. Because of their great size, they carry heavier loads than planes can.



Margaret Bourke White

BOARDING A LARGE AIRPLANE

United Air Lines Photo

PASSENGERS ON BOARD A LARGE AIRPLANE

You have read the story of Fernando Magellan (mȧ-jĕl′ăn), one of whose ships sailed entirely around the world in 1519–1522. It took three years to make that voyage; but in 1929 the famous German dirigible, the *Graf Zeppelin,* made a flight around the world in twenty days and four hours. In 1926 the Norwegian explorer Amundsen (ä′mŭn-sĕn) sailed over the North Pole in a dirigible. In May, 1936, the world's largest airship, the *Hindenburg,* made its first trip across the Atlantic from Germany to Lakehurst, New Jersey.

Ewing Galloway

THE HINDENBURG at Lakehurst, New Jersey. From a photograph taken by a camera on an airplane. Notice how small the people on the field look, because they are so far away.

This giant of the air was twice as big as the *Graf Zeppelin.* It was almost three times as long as a football field. In May, 1937, it was destroyed by fire.

We have good means of air transportation today because in past years men had new ideas and then spent years trying to make them work in a practical way. Such inventors are still experimenting. We can hardly guess what the air transportation of the future will be like. Will it affect our ways of living as much as have steamships and trains and automobiles?

A Picture Time Line

Make a time line of the steps in air transportation described in the story. Draw and cut out the models for the time line. Do not forget the dates.

For Your Museum

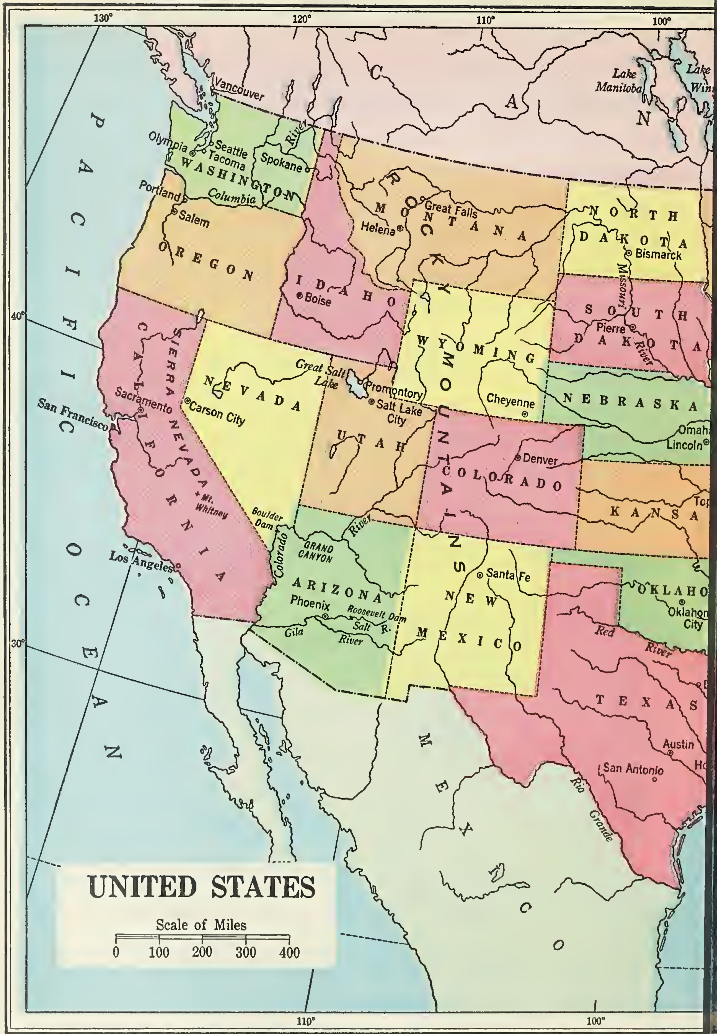
Make pictures and models of balloons, dirigibles, and airplanes.

New Words

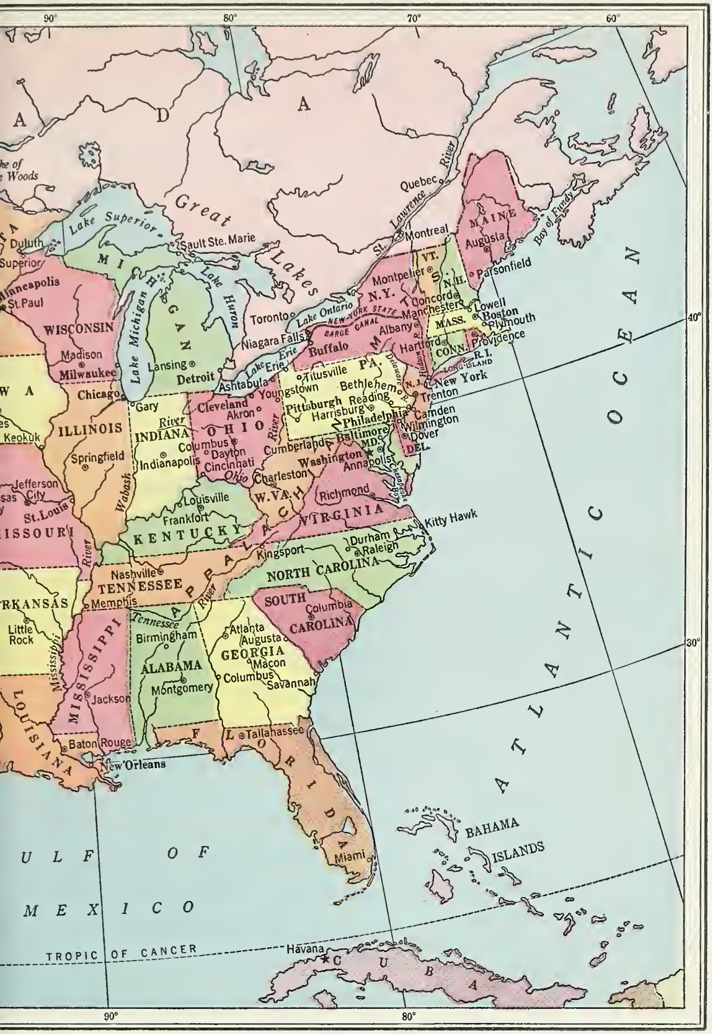
Look up the words *aviation, airplane, balloon,* and *dirigible* in the dictionary. Make a list of all the new words you can think of which are used in aviation.

Map Study

In earlier pages, when you read such names as Boston, Philadelphia, Ohio, and North Carolina, did you know just where those cities and states are located? Point to them on a wall map or on the map on pages 136–137. Remember to refer to this map and other maps whenever needed.



HAGSTROM COMPANY, INC., N.Y.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Toronto
Niagara Falls
Duluth
Superior
Minneapolis
St. Paul
WISCONSIN
Madison
Milwaukee
MICHIGAN
Lansing
Detroit
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OHIO
Cleveland
Akron
Columbus
Dayton
Cincinnati
Ohio River
Ashtabula
Erie
Youngstown
Buffalo
PA.
Titusville
Pittsburgh
Bethlehem
Reading
Harrisburg
Philadelphia
N.Y.
Albany
Hudson R.
Delaware R.
N.J.
New York
Trenton
Camden
Wilmington
Dover
DEL.
MD.
Baltimore
Cumberland
Washington
Annapolis
Chesapeake Bay
W.VA.
Charleston
VIRGINIA
Richmond
Kitty Hawk
KENTUCKY
Louisville
Frankfort
Jefferson City
St. Louis
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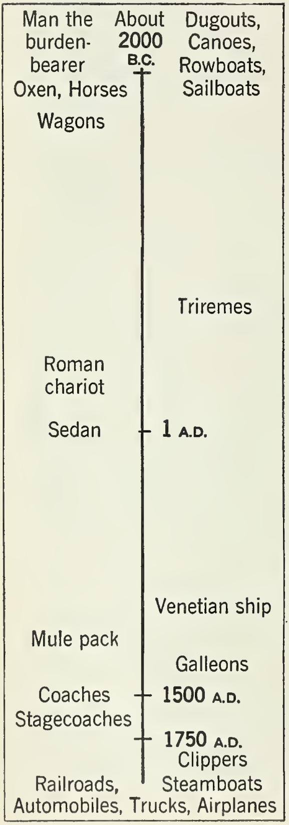
NORTH CAROLINA
Durham
Raleigh
Nashville
TENNESSEE
Memphis
Tennessee River
APPALACHIAN MTS.
ARKANSAS
Little Rock
MISSISSIPPI
Jackson
ALABAMA
Birmingham
Montgomery
GEORGIA
Atlanta
Augusta
Macon
Columbus
Savannah
SOUTH CAROLINA
Columbia
LOUISIANA
Baton Rouge
New Orleans
FLORIDA
Tallahassee
Miami
VT.
Montpelier
N.H.
Concord
Manchester
MASS.
Lowell
Boston
Plymouth
CONN.
Hartford
R.I.
Providence
LONG ISLAND
MAINE
Augusta
Parsonfield
Bay of Fundy
ATLANTIC OCEAN
GULF OF MEXICO
TROPIC OF CANCER
BAHAMA ISLANDS
Havana
CUBA

6

The Transportation Time Line



The time line here shows us that for thousands of years man slowly improved his ways of traveling and carrying goods. He learned to make animals carry his burdens; his crude carts became wagons and carriages and stagecoaches; but he could not travel very fast. Man early learned to travel on water in dugouts and canoes, and later with the help of oars and sails he sent his boats over the seas. A hundred years ago his sailing boats had become large and beautiful and speedy. But steamboats were invented, and soon began to carry most of the goods and passengers that travel on the oceans, rivers, and lakes of the world.

In the small space on the time line that shows the last 150 years we have to crowd in many trains, freight cars, automobiles, busses, trucks, steamboats and airplanes. What a change there has been in our ways of carrying goods and people in recent times! Faster and better means of transportation have helped to make the ways of living we have today.

Your Transportation Time Line

You have made time lines of boats, trains, automobiles, and airships. Copy the transportation time line into your notebook. Draw pictures to show how the different boats and machines look.

Testing Game

How much do you remember about transportation? Write in your notebook the answers to these questions:

When was the first successful steamboat invented?
When was the locomotive invented?
When was the automobile invented?
When was the airplane invented?

Who invented the first successful steamboat?
Who invented the locomotive?
Who invented the automobile?
Who invented the airplane?

Reading Time

When you look in the card catalogue or on the shelves of the library, you will see that there are many books that tell how men have learned to travel and carry goods. See which of these books you can find in the library. Maybe the librarian will show you some that are not named here. Ask to bring the most interesting books you find to your classroom so that all the boys and girls may enjoy them. The encyclopedias will give you information about the way steamboats, locomotives and automobiles "work."

Books That Tell Stories about Transportation:

Beeby, D. J., and Beeby, D., *How the World Grows Smaller.*
Bush, M. G., and Waddell, J. F., *How We Have Conquered Distance.*
Carpenter, Frances, *The Ways We Travel.*
Chamberlain, J. F., *How We Travel.*
Eaton, Jeanette, *The Story of Transportation.*
Fox, Florence C., *How the World Rides.*
Lansing, Marion F., *Man's Long Climb.*
Unit Study Books, No. 505: *Transportation.*
Walden, Arthur T., *Harness and Pack.*
Webster, Hanson Hart, *Travel by Air, Land, and Sea.*
Williams, Archibald, *Romance of Modern Locomotion.*

Books about Boats:

Gimmage, Peter, *The Picture Book of Ships.*
Harlow, Alvin F., *When Horses Pulled Boats.*
Holland, Rupert S., *Historic Ships.*
Irwin, Helen, *Paddles to Propellers.*
Lent, Henry B., *Full Steam Ahead! Six Days on an Ocean Liner.*

Petersham, Maud, and Petersham, Miska, *The Story Book of Ships.*
Picture Scripts: *The Tugboat.*
Pryor, William C., *The Steamship Book.*
Starbuck, Wilson, *Down the Ship's Ways.*
Unit Study Books, No. 303: *Boats.*

Books about Trains:

Hartnell, F. S., *All About Railways.*
Lent, Henry B., *Clear Track Ahead!*
Nathan, A. G., and Ernst, Margaret, *The Iron Horse.*
Petersham, Maud, and Petersham, Miska, *The Story Book of Trains.*
Picture Scripts: *Trains.*
Pryor, William C., *The Train Book.*
Unit Study Books, No. 301: *Trains.*
Van Metre, T. W., *Trains, Tracks and Travel.*

Books about Automobiles:

Lent, Henry B., *Wide Road Ahead! The Building of an Automobile.*
Reck, Franklin M., *Automobiles from Start to Finish.*

Books about Aviators and Airplanes:

Crump, Irving, *The Boys' Book of Airmen.*
Dobias, Frank, *The Picture Book of Flying.*
Fraser, C. C., *Heroes of the Air.*
George, Lloyd, and Gilman, James, *Air, Men, and Wings.*
Petersham, Maud, and Petersham, Miska, *The Story Book of Aircraft.*

Pryor, William C., and Pryor, Helen S., *The Airplane Book.*

Rogers, Agnes, *Flight; The Story of Aviation in Pictures and Text.*

Unit Study Books, No. 302: *The Story of Flying.*

Talking Time

Probably you have read stories about the invention of the wheel and the importance of the wheel in our ways of living. On pages 395–400 of *Where Our Ways of Living Come From* you will find a story about the wheel. Maybe you would like to tell this story to the class.

Ask the teacher to read you some of the stories in Arthur T. Walden's *Harness and Pack,* which is an interesting book about the way animals have helped and still help men to carry their goods. Mr. Walden went with Admiral Byrd on his first expedition to the Antarctic.

For a story about the history of boats see pages 389–394 of *Where Our Ways of Living Come From.* In *Stories of Useful Inventions,* pages 166–186, S. E. Forman tells the story of boats from the days of floating logs to the days of floating palaces. For stories about the invention of the steamboat see Bachman's *Great Inventors and Their Inventions,* pages 25–49; Perry's *Four American Inventors,* pages 42–69; Bush and Waddell's *How We Have Conquered Distance,* pages 77–83. For descriptions of ships of today see pages 204–226 of Carpenter's *The Ways We Travel,* pages 83–86 of Bush and Waddell's *How We Have Conquered Distance,* and the pictures in the library books.

In "The Carriage," S. E. Forman, on pages 144–165 of *Stories of Useful Inventions,* tells of transportation from the days of primitive man to the early days of the airplane.

You can find a good story about "George Stephenson and the Invention of the Locomotive" in pages 50–71 of Bachman's *Great Inventors and Their Inventions.* For more stories about locomotives and trains, see pages 78–117 of Carpenter's *The Ways We Travel,* and pages 62–75 of Bush and Waddell's *How We Have Conquered Distance,* and the library books.

You can find stories of the invention of the automobile in Carpenter's *The Ways We Travel,* pages 136–147; Bush and Waddell's *How We Have Conquered Distance,* pages 120–132, and the library books.

There are many stories about the invention and improvement of the airplane. Three books have the story:

Carpenter, *The Ways We Travel,* pages 227–250.
Bachman, *Great Inventors and Their Inventions,* pages 253–261.
Bush and Waddell, *How We Have Conquered Distance,* pages 134–152.

7

Roads Made of Water

Ewing Galloway

A Small Part of the Harbor of New York. Notice the many piers stretching out into the water like pointing fingers. New York has one of the greatest and busiest harbors in the world.

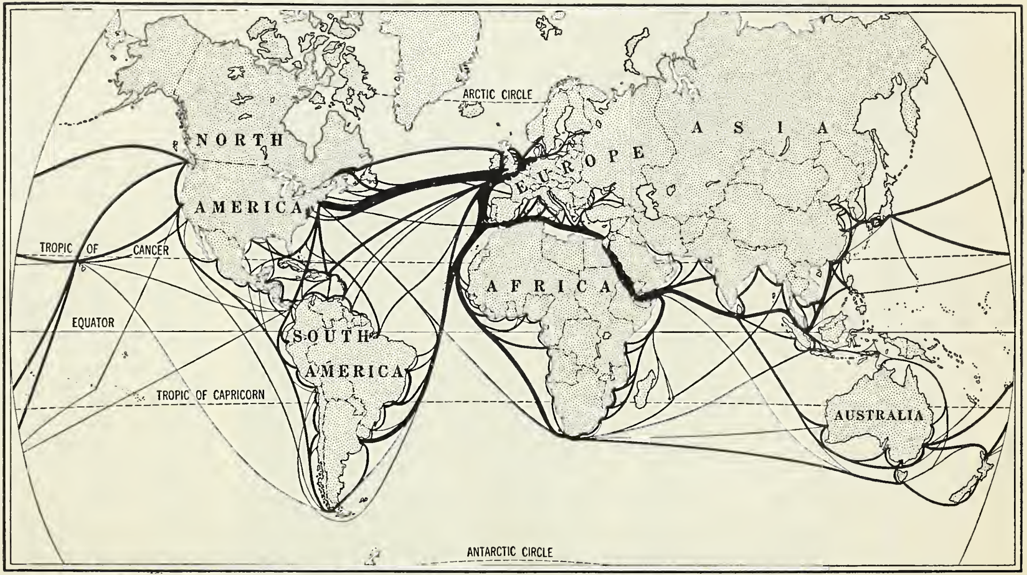
Imagine you are on a small gasoline launch sailing about the harbor of New York. As you sail from one pier to another, you see hundreds of ships. They fly flags of almost all the trading nations of the world.

At one pier you find a fruit boat just returned from Central America, loaded with bananas. You watch the unloading machine quickly take off 75,000 bunches of bananas and carry them to the refrigerator cars standing near by. At another pier you see oil tankers from Texas. At another is a freighter from Norway filled with lumber for the paper mills of America.

Suddenly, you hear music and the voices of hundreds of people. A big ocean liner is ready to sail for Europe. The band is playing, and crowds of people are waving good-by. You hear a long, low whistle, and finally you see the big ship move away from the dock and down the harbor.

When the big liner is out of sight you hurry over to watch a small steamer that has just come to dock at the opposite wharf. The small steamer is not so beautiful as the big liner and there is no music or waving of handkerchiefs for her. But the sailors on this ship can tell you many an interesting story, for they have been in many places since they left the harbor of New York. This small steamer is a tramp steamer.

The tramp steamer started out of New York harbor months before with a cargo of steel rails which she delivered at Buenos Aires (bwā′nos ī′rās). At Buenos Aires she unloaded her steel and took on a cargo of hides and fruit which she took to New Orleans (ôr′lē̇-*ă*nz). At New Orleans she reloaded with steel rails for Yokohama (yō-kō̇-hä′mȧ), Japan. On and on



Chief Ocean Highways of the World

she sailed, from one port to another, until she had been over nearly every important ocean route of the world.

Waterways are routes or paths through the oceans, rivers, lakes, and canals. Waterways are very old paths. As soon as primitive men learned how to make dugouts, waterways began to be used for exchanging goods and ideas.

Water transportation is slow compared with trains, automobiles, and airplanes, but it is cheaper. Expensive roads do not have to be built and kept in repair for boats. Whenever merchants can do so, all over the world, they ship their bulky and heavy goods by freight along waterways.

OCEAN HIGHWAYS

The map on pages 18–19 shows where the most important waterways of the world are located. Are you wondering why the line across the North Atlantic between North America and Europe is so wide? It is because that route is the most important ocean route in the world. More people travel between North America and Europe, and more goods are shipped that way, than over any other water route. As the ships leave the American ports for Europe they are filled with manufactured goods, farm products, and raw materials. Some of these ships go to London, England; others go to Hamburg, Germany, or to Copenhagen (kō-p'n-hā'gĕn), Denmark, or to Le Havre (lẽ-ȧ'vr'), France, or to some other busy harbor of

Europe. When the ships come back they bring lumber, toys, cheese, fish, fruit, cloth, and other things which the American people can use. Books and music and moving pictures, too, are carried on this route.

The many travelers who go back and forth between Europe and America help to make the North Atlantic route very important to our ways of living. When people visit foreign countries they become acquainted with the people living there and with their ways of living. As people of different nations become acquainted with one another, they help to make a more friendly world.

The old, old routes connecting the ports of the Mediterranean Sea are much busier today than in ancient times when the Phoenician traders used them. The people living in Europe now want even more of the spices and silks of the Far East than they did in the Middle Ages. So the routes from northern Europe to India, China, and Japan, are very busy.

If you could visit one of the very busy ports along the west coast of America you would see how very much trade is carried on the ocean routes between America and China, Japan, and Siberia. To watch the cargoes unloaded would be interesting, too. One can easily tell where the silk and tea, straw matting, and rice come from! We can guess, too, where the cargoes of fresh fish and canned salmon come from. From our western ports cargoes of steel and machinery and oil sail across the Pacific Ocean to the countries

Ewing Galloway

Part of the Harbor of San Francisco, one of the largest of our western ports. The harbor is crossed by the longest bridge in the world, connecting San Francisco with Oakland.

of the Far East. Did you know that from the port of Los Angeles (lōs ăng′gĕl-ĕs) more oil is shipped than from any other port in the world?

Coffee and cocoa and fruit grown in the countries of South America are eaten in many a home of North America and Europe. The routes that connect South America with the rest of the world carry more and more traffic every year.

River Roads

Have you heard stories or seen pictures of the old castles on the river Rhine? The ruins of the old castles along the Rhine remind us that even in the Middle Ages the Rhine was a busy waterway. Traders had to pay toll to the owner of a castle if they wanted to sail past it. So much trade was carried on along the Rhine that some of the knights who owned the castles grew very rich.

Rivers were the first important waterways. The earliest civilized people we know about made use of rivers to exchange goods and ideas. The Egyptians used the Nile. The Babylonians used the Tigris and the Euphrates. Since ancient times many other rivers have become important highways of trade.

Besides the Rhine, there are many busy rivers in Europe (map, page 40). The Volga is a very long river of Russia. The Volga boats, once towed along by men, are now run by steam. They carry many kinds of products. The boats going north carry cotton, oil, fruits, and coal. On the way south, the boats are filled with lumber, grain, and machinery; and on top of a boat, there may even be a house built in the north and to be delivered to a family in the south.

The Danube, another long and busy river of Europe, flows through seven countries before it empties into the Black Sea. But the length of a river does not always decide how important it will be as a waterway. One of the shortest rivers in Europe is one of the busiest in the world. It is the Scheldt (skĕlt) River which flows through Belgium. Ships bring raw materials to the busy manufacturing cities along the Scheldt, and carry away cotton, linen, and woolen cloth, iron and steel plate, and window glass.

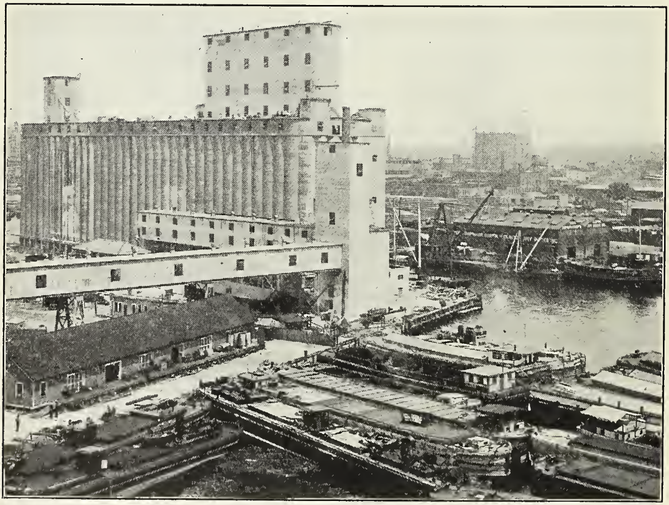
Are you wondering whether the United States has any busy rivers? The great Central Plain of the United States is crossed by the Mississippi River and its tributaries. More trade is carried on over those busy waterways than on any other river system of the world. Barges filled with coal, iron, steel, and heavy machinery travel down the Ohio River to the Mississippi. Other boats carry iron ore and wheat from the North Central states; corn, hogs, and cattle from the Central states; and cotton, sugar, rice, and fruit from the Southern states. Many of the boats on the Mississippi go all the way down to New Orleans, the thriving port near the mouth of the river.

There are many other busy rivers in our country and in other parts of the world. Can you name several that flow into the Atlantic Ocean?

CANALS

When DeWitt Clinton was elected governor of the state of New York, more than a hundred and twenty years ago, many people were moving from the eastern part of the United States to the West. The amount of trade between the East and the West was greater every year. In those days roads were very bad and in many places there were no roads at all. And, of course, there were no railroads. Traveling and trading were very difficult.

Governor Clinton thought that if a canal could be cut from the Hudson River to Lake Erie (ēr'ĭ) it would make a cheap and easy way to carry goods and people a long distance. Few people agreed with Clinton. Almost everyone laughed at him, and even scolded him roundly for wanting to waste money. But Clinton would not be discouraged. By 1825 "Clinton's Big Ditch," which was named the Erie Canal, was finished. It was 362 miles long, forty feet wide, and four feet deep. Not very deep or wide, was it? But it became so popular and carried so much



Courtesy State of New York Department of Public Works

Many boats on the New York State Barge Canal now go also on the Hudson River to this terminal dock in Brooklyn. Here you see, too, a public elevator where 2,000,000 bushels of grain can be stored.

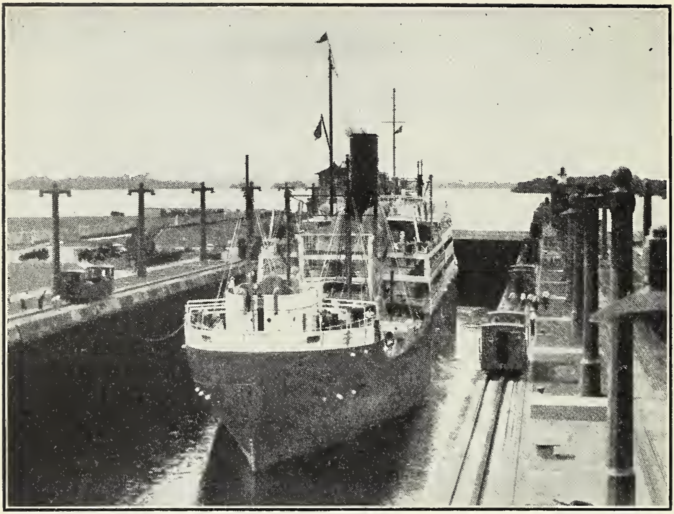
traffic that in a very few years the tolls collected on it paid the cost of building it, and put money into the treasury of New York state.

A few years ago the Erie Canal was deepened and widened, and its course was changed, in some parts. The name was changed, too. Today it is called the New York State Barge Canal and is part of one of the most important routes between New York harbor and the Middle West.

DeWitt Clinton taught the people of New York state how helpful canals can be. The people of ancient times had learned that lesson. Four thousand years ago the Egyptians built a canal to connect the Red Sea with the Nile River. Other ancient nations, too, found it wise to build canals. Canals shorten some water routes, and make it possible to have waterways where there are not natural ones.

For many years the countries of Europe have understood how much canals help in transportation. So many canals link the rivers of Europe together that in some places they form a regular network of waterways. Goods can be shipped very cheaply in these countries because they can travel long distances on waterways made up of rivers and canals.

In 1869 the Suez (sōō-ĕz′) Canal was built to make a short waterway between Europe and the countries of the Far East. Since the Mediterranean Sea and Red Sea have been connected by the canal, trade in the Mediterranean has become fifty times as great as it was before.



James Sawders

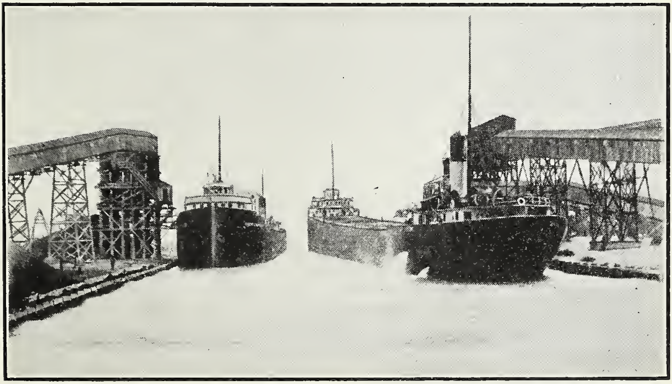
IN A LOCK ON THE PANAMA CANAL. A lock has a gate at each end, opened one at a time, so that a ship can be raised or lowered from the level of one part of the canal to the level of the next part.

You will find the Panama Canal in a very narrow strip of land on the Isthmus of Panama. The Panama Canal was built to shorten the waterway between eastern America and western America. Before it was built, ships had to go all around the farthest point of South America to get from east to west or from west to east. Now they can go right through the canal. The Panama Canal saves many hundred miles in the journey from one side of America to the other.

There is a very short canal in the United States that was built to make a long waterway. It is the

Chicago Drainage and Ship Canal that connects the Mississippi River system with Lake Michigan at Chicago. This connection makes it possible for goods to be shipped from Chicago and other cities on the Great Lakes all the way down the Mississippi to the Gulf of Mexico.

The Great Lakes are the most important lakes in the world used for transportation. They can be used for water traffic from end to end, and make a waterway fifteen hundred miles long. Since the river that flows from Lake Superior to Lake Huron is very dangerous for boats, canals have been dug to handle the traffic of Lake Superior. Today these canals carry more traffic than the Panama and the Suez canals together. More iron ore is shipped through these canals than through any other part of the world!



Michigan Department of Conservation

Freight Steamboats Used on the Great Lakes

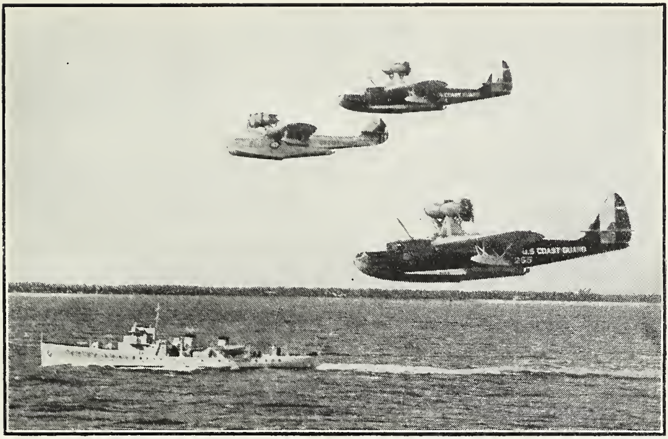
Making Waterways Safe

The United States, as well as other countries of the world, does many different things to make waterways safe. Lighthouses and lightships send out their beams to warn seamen of rocky coasts and shallow water. Buoys are anchored on each side of the channel in all harbors and along rivers to guide ships through the safest paths. Buoys are placed also to mark hidden wrecks, sandbars, or rocks.

The government publishes maps of the waterways to help the pilots guide their ships. Such maps are called *nautical maps*. Nautical maps tell where to look for buoys, for lighthouses, and for hidden wrecks, and give other signs which help the pilot to guide his ship safely.

Along the seacoasts and on the shores of many of the inland waterways are Coast Guard stations. Coast Guard stations are equipped with boats and lifesaving apparatus to use when accidents occur. Coastguardmen patrol the shores to watch for signs of danger. In the North Atlantic where icebergs make traveling dangerous, coastguardmen are on duty all the time to send out warnings.

Since wireless and radio have been invented, travel along the waterways of the world has become much safer. With the help of wireless and radio, a ship can send out calls for assistance which can be picked up either near by or far away. It can receive warnings of



Gendreau

AIRPLANES AND PATROL BOAT OF THE COAST GUARD, near Miami, Florida.

icebergs, storms, and the location of ships surrounded by fog.

In ancient times, in the port of Alexandria, Egypt, the government erected a lighthouse. It was a high pillar with a bowl at the top. In the bowl a fire was kept burning all night long to help sailors on the Mediterranean Sea. Now, as in ancient times, the governments of the world try to make the waterways safe for travel, for waterways are important highways of trade.

Using the Map

On maps find the places mentioned in the story. Trace the waterways that the story tells about.

Making Lists

Make a list of some of the products which come over the waterways from Europe, China, Japan, and India to the United States.

Make a list of the most important rivers of the world.

Making a Map

Draw a map of the Mississippi River and list beside it some of the products it carries from place to place.

A Picture Exhibit

Bring to class pictures that show how waterways help in exchanging the goods of the world. Maybe you will want to save some of the pictures for your museum.

Committee Reports

Divide your class into four groups. One is to prepare a summary about oceans, one about rivers, one about canals, and one about safety on water highways. Let a member of each group read or tell its summary to the class. Find more information about your topic in library books and encyclopedias. Find pictures to make it interesting to others. Use maps to make your ideas clear.

8

Railroad Tracks of the World

One Monday morning in February, 1827, as Philip E. Thomas, a merchant in Baltimore, was on his way to his office, he was thinking over a problem that was troubling many people in Baltimore. Two years earlier, in New York state, the Erie Canal had been opened, and now goods were being carried more quickly and cheaply between New York and Buffalo than before. But goods carried between Baltimore and the new towns in the Ohio Valley still had to come and go by horse across the mountains or by water by way of the Atlantic Ocean, the Gulf of Mexico, and the Mississippi and Ohio rivers.

Ever since the days of George Washington men had thought about building a canal that would connect the Ohio River and Chesapeake (chĕs′*ȧ*-pēk) Bay. A canal across the mountains would cost a great deal. Besides, for part of the way, no one was certain that there would be enough water to keep the canal filled.

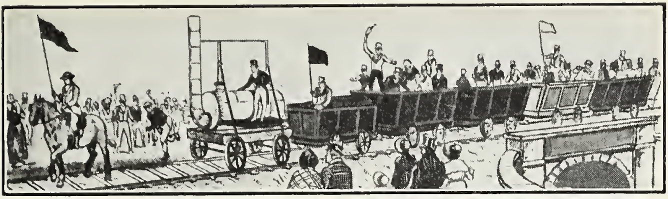
Still thinking over the troublesome problem, Philip Thomas reached his office. Among the letters he found there, was one from his brother Evan, who was in London on business. He read the letter, thought a while, and then sent a messenger to ask George Brown, a banker in Baltimore, to come to the office.

"Friend Brown," said Philip Thomas, when the banker arrived, "I have a letter from my brother in England which, I think, will interest thee. It tells of a plan to build a road from Liverpool to Manchester over which carriages will be drawn upon iron rails. Some say this will be a cheaper and quicker way of hauling goods than even a canal."

After some more discussion the two men decided to call together a few friends to talk over plans for a railroad. So it happened that twenty-five men of Baltimore met that evening to talk about the possibility of building a railroad from their city to the West. After that evening they met often to make plans for the building of the Baltimore and Ohio Railroad.

Some of the men in the new company went to see the short lines of track that had been laid in Massachusetts and Pennsylvania for hauling stone and coal. Finally nine men were sent to England to see for themselves how George Stephenson was building the railroad between Manchester and Liverpool.

The Liverpool and Manchester Railway was not the first railroad that Stephenson built. One famous railway which he built, the Stockton and Darlington, was already carrying passengers as well as freight. Even though Stephenson had already shown what a good railroad builder he was, he had difficulty in getting permission to lay the Liverpool and Manchester Railway. At last, however, after much discussion

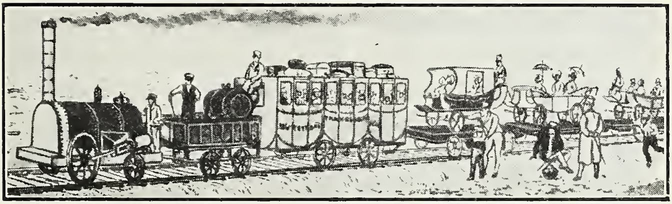


Courtesy Associated British and Irish Railways, Inc.

AN EARLY ENGLISH RAILWAY. The first train on the railway between Stockton and Darlington, 1825.

and argument, the British Parliament gave Stephenson permission to start work on the railroad.

In one place Stephenson had to build his railroad across a bog four miles wide. He had his men drain and fill in the bog. He built embankments on which the rails were laid. For this one railroad Stephenson built sixty-three bridges to carry the rails, and under part of Liverpool he dug a tunnel. At last, in 1830, about two years after the visit of the nine men from Baltimore, the Liverpool and Manchester Railway was opened. It quickly showed how convenient railroads were for carrying goods and passengers.



Courtesy Associated British and Irish Railways, Inc.

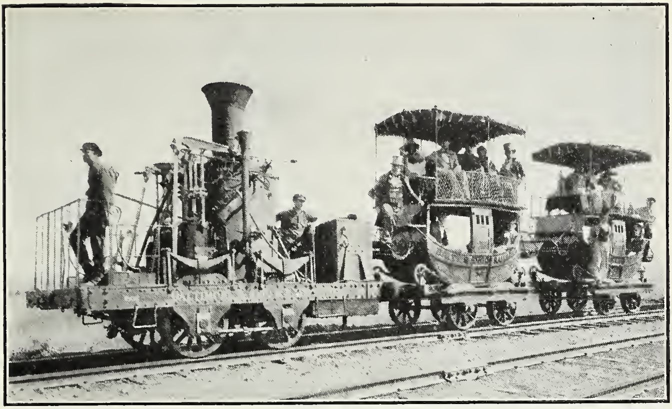
ANOTHER EARLY ENGLISH RAILWAY. First-class train on the Liverpool and Manchester Railway, 1830.

Just as the rails of some of the railways built for carrying coal were laid four feet, eight and one-half inches apart, so too the rails of the Liverpool and Manchester Railroad were laid four feet, eight and one-half inches apart. Later other widths were tried out, but in time this width came to be known as the "standard gauge" for railroads.

George Stephenson lived to see the days when thousands of miles of railroad became the "Great Highway" for millions of people in many parts of the world. Over many of them trains were pulled by locomotives built according to Stephenson's designs.

On July 4, 1828, the Baltimore and Ohio Railroad was begun. By May, 1830, passengers and freight could travel thirteen miles on the new railroad in horse-drawn coaches or wagons. In August, 1830, the *Tom Thumb* made the first locomotive trip on the Baltimore and Ohio Railroad, and shortly after that trip locomotives did most of the hauling there.

After 1830 many short railroad lines were being built in Europe and America. These early railroads usually connected two cities, or connected inland places with waterways. The many builders of short railroad lines had no one plan they followed. Of course the builders who bought engines made from Stephenson's designs laid their rails four feet, eight and one-half inches apart. Some builders made their roads less than three feet wide and some built theirs more than six feet wide.



An Early Train on the Baltimore & Ohio Railroad. Compare it with the still earlier locomotive and car shown on page 116.

We can easily understand how inconvenient it was to travel when passengers had to change cars to suit the width of the tracks. In the 1850's in our own country, a person who wished to travel from Albany to Buffalo, New York, by rail had to make the trip on ten different short railroad lines. Think what changing freight so often between Buffalo and Albany meant in time, labor, money, and damage to the goods being shipped.

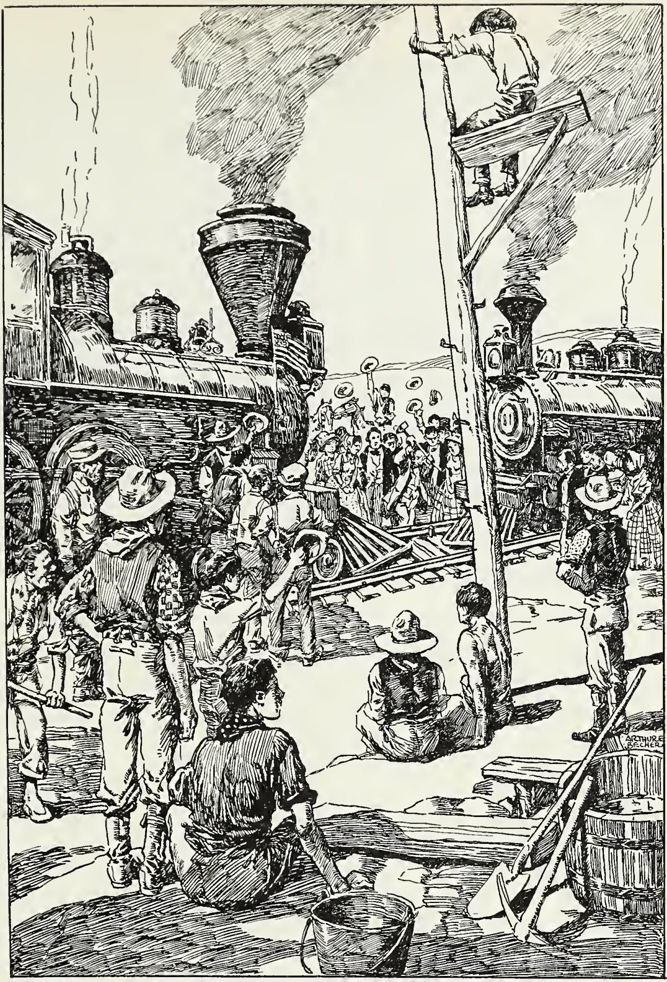
It did not take many years for people to see ways of improving railroad transportation. In New York state a group of businessmen headed by Cornelius Vanderbilt bought up the short lines between Albany and Buffalo, and other lines. Where necessary, they had the tracks relaid to make them "standard gauge."

In this way they made the New York Central Railroad, which in time extended from New York City to Chicago and had also many branch lines. In the same way short lines were bought by other groups of businessmen to make the Erie Railroad, the Pennsylvania Railroad, and other big railway systems.

When the railroads reached Chicago, they had gone only about one third of the way across our vast country. You may be sure that from the earliest days of railroads there were dreams of a railroad that would cross the entire continent. There was much disagreement about where the railroad should be built, and then the War between the North and the South came and made it impossible to start such a tremendous task. When the war finally ended, work was at last begun on a railroad across the country.

Two companies, the Union Pacific and the Central Pacific, were to build the railroad. The Union Pacific began work at Omaha (ō′mȧ-hô), Nebraska, and the Central Pacific at Sacramento, California. Each company tried to build and own as long a part of the railroad as it could.

In spite of many difficulties, the work went on rapidly. The workers at the two ends of the railroad had contests to see which could lay the most miles of track. "Back east" the people read eagerly in their newspapers the stories of the progress of the railroad. Finally, on May 10, 1869, the railroad crews from the west and the crews from the east met



This picture shows the meeting of Union Pacific and Central Pacific trains and workmen, May 10, 1869. Why are the people celebrating?

near Promontory (prŏm′ŭn-tō-rĭ), Utah, and the last spike was pounded into the 1,800 miles of track that had been laid. The first transcontinental railroad was completed. At last it was possible to transport goods and passengers by rail from New York to San Francisco.

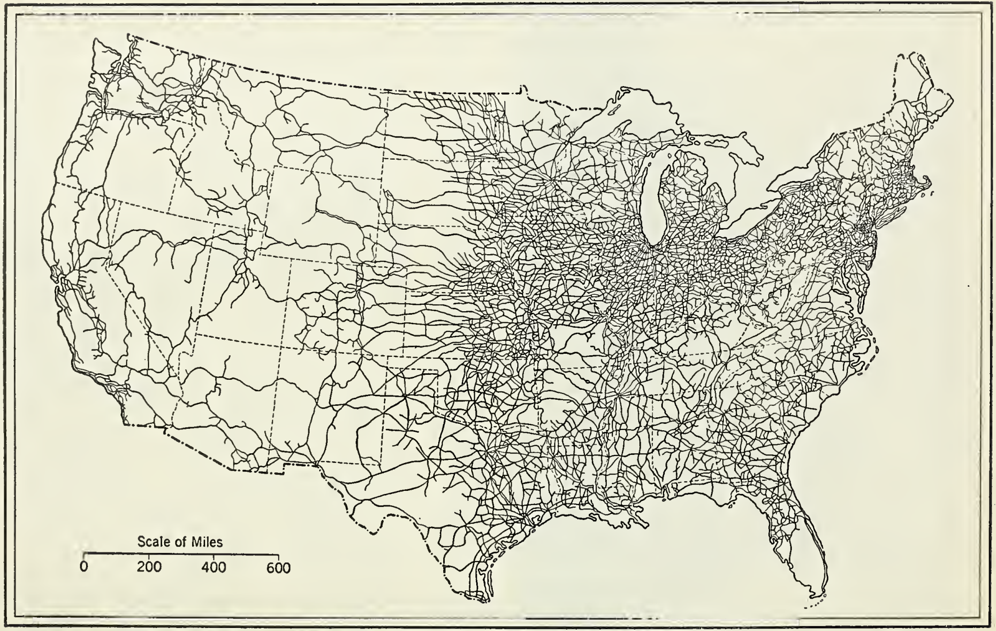
In the years that followed, five other transcontinental lines were laid in the United States and helped greatly in the growth of our country. In Canada, too, a transcontinental line, the Canadian Pacific, was built from Montreal (mŏnt-rė̂-ôl′) to Vancouver (văn-kōō′vẽr). In the countries of Europe small lines were joined to make longer and better railroad systems. Usually when small lines were bought and made part of a large system, the tracks were laid on the standard gauge. In Great Britain today there are four great railway systems, and in France, seven. In some countries of Europe most of the railway lines are owned by the government, and in all countries with many miles of railroad, the government has much to say about the way they shall be managed.

In 1904 the Russian government completed the great Siberian Railway which connects Leningrad with Vladivostok (vlȧ-dĭ-vŏs-tôk′), on the Pacific. The Russian government is making improvements in this railroad, which is the longest in the world. In Africa work is still going on in the building of a railroad which is to connect the Cape of Good Hope with the Mediterranean Sea.

Associated British and Irish Railways, Inc.

The "Royal Scot," a modern train on a railroad in England. How does it compare with the modern American train on page 110?

As you read more about railroads you will doubtless want to learn about the great engineering feats of railroad builders. There are interesting stories about such achievements as the building of the Hoosac Tunnel in western Massachusetts, which took twenty-four years to complete. The Central Pacific Railroad built fourteen tunnels in crossing mountain ranges in the Far West. A long stretch of that railroad, to shorten its route, now crosses part of Great Salt Lake in Utah (see picture on page 110). High up in the Alps are wonderful tunnels, such as the St. Gotthard (gŏt′ẽrd) and the Simplon. When engineers were building the Simplon tunnel they had to overcome



RAILROADS OF THE UNITED STATES

such obstacles as terrific heat in the interior of the rocks, tremendous pressure from the rocks, and the sudden appearance of water.

As you study the map on page 168, very likely you ask yourself the question, "Are we through building railroad tracks?" Probably in the United States, Canada, and Europe there will not be many new railroad systems built, but always there is the work of keeping present railroads in repair. The rails used today are made of fine durable steel instead of iron as they were in the days of Stephenson. In China, India, and other thickly settled countries of Asia, it may be that thousands of miles of railroad tracks will be built in the years to come.

The railroads of the world are used by many famous express trains. Daily between New York and Chicago, runs the "Twentieth Century," a thousand miles in about sixteen hours! The "Broadway" is another famous train between New York and Chicago. The "Sunset Limited" connects New Orleans and the Pacific Coast. The "Hiawatha" runs from Minneapolis (mĭn-ē̇-ăp′ō̇-lĭs) to Chicago—four hundred miles in four hundred minutes. In England the "Flying Scotsman" connects London and Edinburgh (ĕd′ĭn-b*ŭ*-r*ŭ*)—from city to city without a stop. In Europe the "Constantinople Express" runs from Berlin to Istanbul (ē-stän-bo͞ol′),—the new name of Constantinople,—and other expresses rush through the Alps from Paris to southern Italy.

Many slower passenger trains and still slower freight trains also are moving on the rails of the world. Each year millions of passengers and billions of tons of freight are carried over shining rails. In some years in the United States alone more than 2,500,000,000 tons of freight pass over the rails of our country. The iron, coal, food, clothing, and countless other things that go to make our ways of living could not come so easily to us if it were not for the railroad tracks of the world and the work of the millions of people who help to transport goods and passengers. The world's shining rails of steel, 750,000 miles long, help to make our ways of living.

Talking Time

Find out all you can about the railroads that run through your community. When were they started? Where do they reach to? What things do they carry?

Does your library have books or clippings which tell about the railroads?

Making Lists

List the most important railroads in the country.

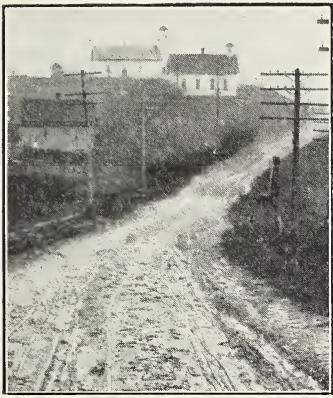
After visiting the freight station nearest you, list the kinds of food brought in, or carried away, by railroad.

Writing Time

Write a story telling why you think railroads are important to our ways of living.

9

A Network of Roads



Courtesy U. S. Bureau of Public Roads

AN UNPAVED ROAD

A GOOD CONCRETE ROAD

One day in May, 1903, two men in an automobile left the city of San Francisco on a strange journey. They were going to try to cross the United States in three months. Their friends shook their heads as they waved good-by. It seemed like an impossible trip. There was no road across the United States for the car to drive on. Do you wonder that almost no one thought the automobile would reach New York?

There were very few paved roads in the United States at that time. Most of the roads were poor and not good to drive an automobile on. In many parts of our country, especially in the West, there were many miles with no roads at all. What a difficult trip for the car to make!

The two men did not know which roads to take. There were no road maps and but few signposts. They had to ask their way from town to town. Sometimes they were lost. Often they had to go miles out of their way because there were no bridges across rivers. The car splashed right through the water of shallow streams. Several times the only way to get across was over a railroad trestle. Imagine how the men must have felt, seated high up in the air as their car bumped over the railroad ties.

The two men would not turn back, however, in spite of danger and hardships. At last, after sixty-three days, they reached New York. Wasn't that a wonderful journey to have made with few good roads and no road maps to help them?

Think how different traveling by automobile is today! Now it is an easy journey across our country. Thousands of people drive automobiles from coast to coast every year. One reason for this is that today we have a great network of good roads in the United States. Our system of roads is plainly marked with signs and route numbers. Automobile road maps, easy to get, help us to choose the best roads to take on any long journey. Over these miles and miles of good roads we may travel comfortably and easily.

Twelve or more main automobile highways cross the United States from east to west and from north to south. Cross roads connect all of the main roads so that people can travel easily from farms and villages to near-by cities and towns.

The Lincoln Highway begins in New York City and ends in San Francisco. It runs through twelve states and follows the shortest and easiest way across the country. It is made up of 3,384 miles of splendid road. A branch road connects Denver, Colorado, with this highway. When we add this road we find that the Lincoln Highway is 3,519 miles long, or the longest roadway in the world. Can you name some of the other famous highways in our country and tell where they run?

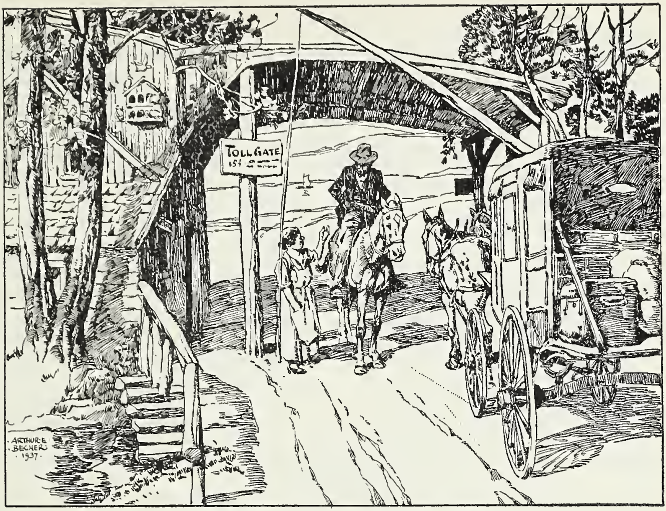
Most of our national highways were built little by little. First one section was finished and then others, one after another. Finally they were joined together to make the network of roads we have today. Fine bridges were built across rivers. Although there are many splendid roads in other parts of the world, half of all the main roadways in the world are in the United States. In all, there are more than 3,000,000 miles of roads in our country.

When our country was first settled there were only the narrow winding Indian trails for roads. Those trails generally followed the paths worn by buffalo, deer, and other animals. The Indian trails went from village to village and to the hunting grounds of the tribes. Our early colonists used those same Indian trails. As they tramped over them the paths were made wider and smoother. In this way our roads began.

The roads were so muddy through the swampy places that the colonists could not drive their coaches and wagons across them. They built corduroy roads to help them over the mud. To do this they laid logs close together, side by side, across the road. These roads were very bumpy to ride over and looked something like corduroy cloth. Although they were very uncomfortable, the settlers were glad that they kept the wagons from sinking into the soft mud.

When George Washington went from Virginia to New York to be inaugurated President of our country, in 1789, the roads were so bad that he could not drive in his coach. He had to make the difficult journey on horseback. The trip took seven days. Today we can make that same journey over fine paved roads in a few hours.

The early roads were so rough and uneven that it was difficult to travel any distance by stagecoach. Often one side of the stagecoach was tipped one or two feet higher than the other. Imagine how uncomfortable it must have been. Stumps of trees left in the road sometimes upset the coaches or tore off their wheels. The roads were narrow. Often there were long distances—even a mile or more—where two carts or coaches could not pass.



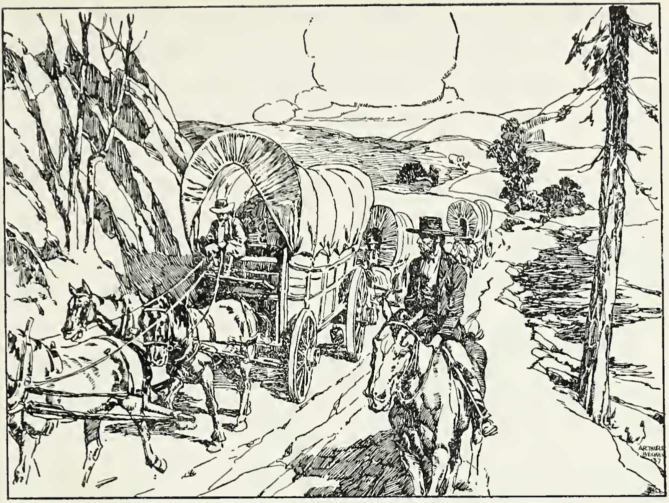
A Tollgate on a Turnpike

The colonists found that they needed better roads so that people and goods could be carried more easily and quickly from place to place. The first improved road in the United States was built in 1711. It was the old York Road which ran between New York and Philadelphia. Stumps and rocks were removed and the road was graded. The colonists thought this a splendid road. Imagine what they would think if they could see the wide paved highways of today!

It cost so much to build and repair these early roads that companies were formed which built roads called *turnpikes*. In 1792 the first of these roads was built in Pennsylvania. It ran between Philadelphia and Lancaster, a distance of 62 miles. Later, especially in New England, hundreds of these turnpikes were built. They were called turnpikes because every five or ten miles there was a heavy gate across the road—a gate often with sharp pickets or spikes. When a stagecoach or a carriage or a drove of cattle wanted to pass by, a small sum of money had to be paid, as a toll, to the gate keeper. He would then open the gate. This money was used to keep the roads in repair. Today we still find toll bridges and tunnels, but most of the roads of our country are free for every one to use.

Early in the history of our country many people began to go west. The turnpikes did not extend far from the Atlantic coast, and there were no railroads. At first the settlers had to travel as best they could with no roads to help them. Then the national government began to make a road to help people move to the new lands beyond the Appalachian Mountains. Because this road began at Cumberland, Maryland, it was called the Cumberland Road. A few miles were built at a time—across the corner of Pennsylvania, then over Ohio and Indiana, until in thirty years it stretched half way across Illinois. Many years later it reached St. Louis.

Thousands of settlers moved west along this road in great Conestoga (cŏn-ĕs-tō′gȧ) wagons. You have seen pictures of these covered wagons loaded with people and household goods on the way to the West.



CONESTOGA WAGONS, on the Cumberland Road.

In fact, until the railroads were built, much of the trade and travel between East and West passed over the Cumberland Road. This road was also called the National Road, for it was built by the national government. Today we call it the National Old Trails Road. It is part of United States Route 40, which goes all the way to Los Angeles.

When automobiles became common it was necessary to have better roads. Cars to give good service must have good roads to travel on. The Lincoln Highway was begun and many other roads were planned. Slowly the network of roads grew until today it covers almost all of the United States.

It costs a great deal to build good roads and keep them in repair. Perhaps you are wondering who pays for them. Roads are so important that towns, cities, counties, and states pay for them by taxes. Even the national government gives money to build new roads and to keep old roads in repair. Although we have many good roads today in the United States our engineers are studying how to build better ones. Probably the roads of the future will be much better and safer than the roads of today.

We know that good roads are not built for pleasure cars alone. The huge trucks that travel day and night over the network of roads carry milk, vegetables, and livestock from farms to city markets. Furniture, lumber, machinery, in fact almost everything that we use today, can be carried over these highways. Boys and girls are taken to school in busses over these good roads. Large comfortable busses carry thousands of people from their homes to their work. Bus lines run from city to city and even from coast to coast. In these large busses people can travel easily and quickly almost everywhere in the United States. In the country, mail can be delivered quickly and regularly, thanks to the good roads. In the winter great plows keep the roads free from deep snow. Men sprinkle sand over the icy roads so that automobiles, trucks, and busses can travel safely.

When you look at a road map of the United States, remember that the red and black lines on it stand for long curving roads of gravel, and macadam, and brick, and concrete. These roads tie all the parts of our country into one great nation. On this great network of automobile roads, people and goods can travel quickly and easily from place to place.

An Exhibit of Maps

Bring to class for your Bulletin Board automobile maps of your state and county and your section of the country. Which maps do you like best? Why?

Taking a Map Trip

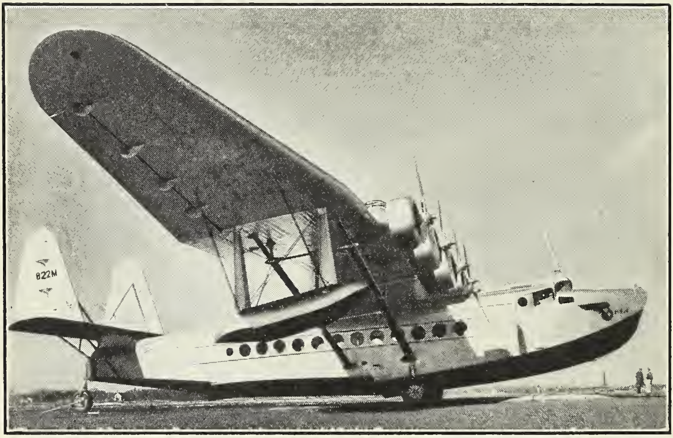
Let each member of the class decide on some far-off place he would like to visit. Then use the map to discover what roads he would have to travel over in order to reach this place.

Using a Map

Trace the Lincoln Highway, or Route 40, on an outline map of the United States. Make a list of other important highways and draw them on your map and in your notebook.

10

Airways of the World



Margaret Bourke White, from Nesmith

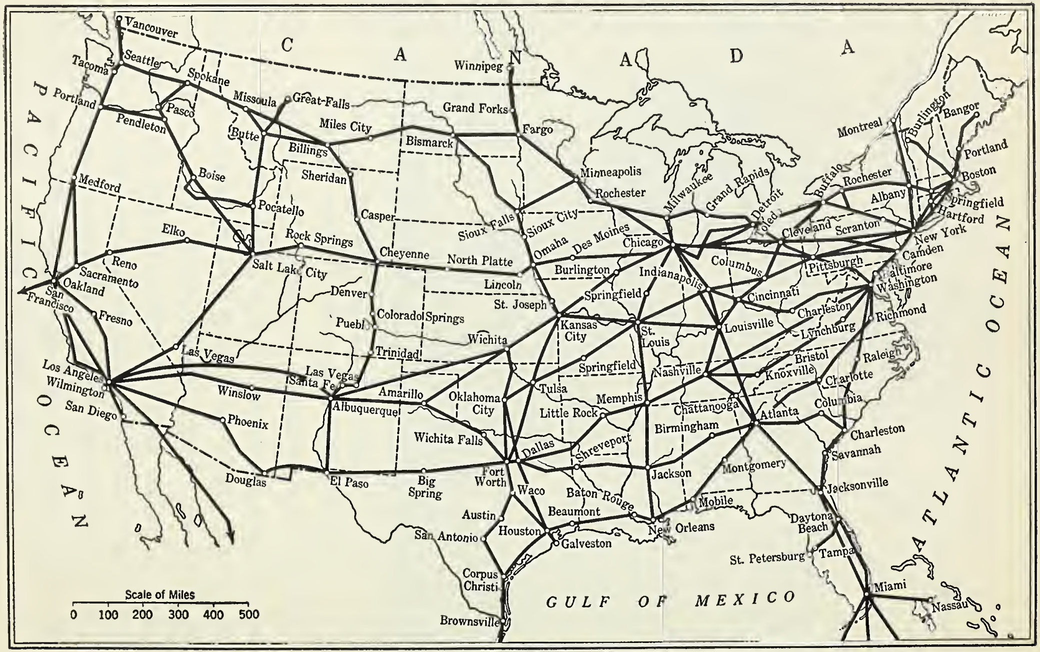
A Pan-American Airway Plane, ready for flight. Notice the four propellers. Compare with the pictures on page 133.

On the afternoon of April 16, 1935, a giant plane rose gracefully, with a roar of its four engines, from the waters of San Francisco Bay. Climbing high above the watching city, it soared out to sea. Nearly 2500 miles of ocean tossed between it and the port for which it was headed, but the bird of metal did not falter. Straight toward the sunset it flew, while back on land radio operators bent anxiously over their instruments, waiting to catch news of the flight.

The airplane company that built the plane had worked and planned for four years to get ready for the great flight. Would the plane succeed in making the hop? Hour after hour the radio reports kept coming from the fliers: "All is well." At last, seventeen hours and forty-five minutes after it had left San Francisco, the plane landed in the beautiful harbor of Honolulu (hō-nȯ-lo͞o′lo͞o). The first passenger plane to cross the ocean from the United States to the Hawaiian (hä-wī′yăn) Islands had stood the test!

A few months later, other passenger planes were making regular trips not only across the stretch from San Francisco to Hawaii but across the whole width of the Pacific Ocean. The fastest steamship needed three weeks to make the 9000-mile trip, but the giant planes did it in two and a half days of actual flying time. In five big hops, from island to island, the airliners reached the Philippine Islands. Each plane could carry eighteen cabin passengers and a heavy cargo of mail and freight across the mighty Pacific.

Besides the networks of roads and railroad tracks and waterways, there is still a fourth network on the map of the world—a network of airways. But these routes do not stop, as the roads and railroads do, when the oceans are reached. Neither do they stop, as most of the waterways do, when land is reached. The airways go on across both water and land until the entire world is circled. The map on pages 18–19 shows only a few of the chief routes.

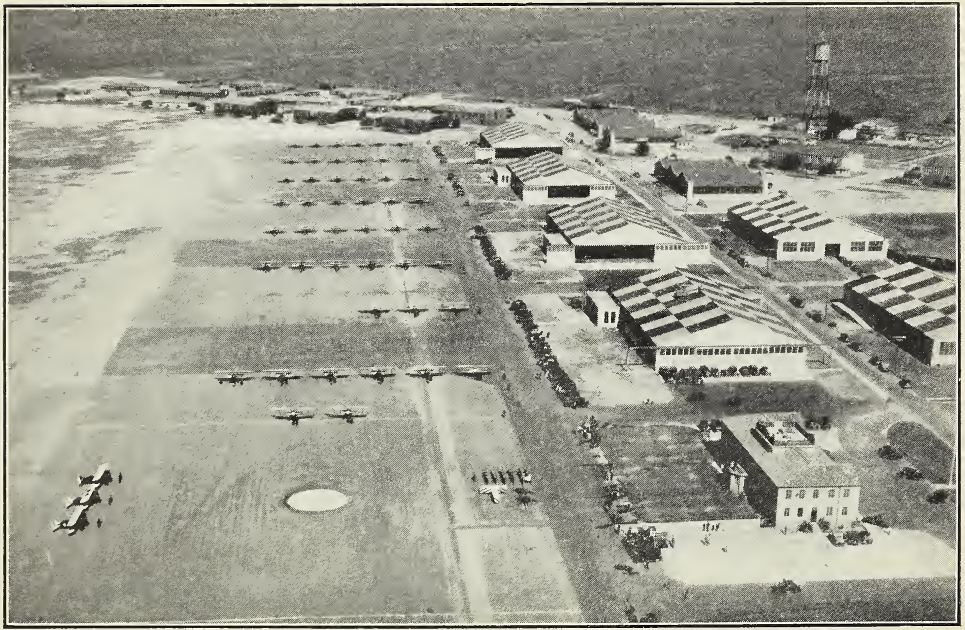


AIRWAYS OF THE UNITED STATES

On the airways of our country many people are at work to make them safe. Mechanics labor day and night keeping the airplanes in repair. There are nine mechanics on the ground for every pilot in the air. Every bolt and screw of a plane is tested before the plane is allowed to fly. After 300 hours in the air the motors are taken completely apart and carefully rebuilt. This care continues all the time.

When the pilot starts his plane upon its journey "upstairs," it looks as if he had all outdoors to choose from for his course. His route, however, is mapped out for him in a straight line from airport to airport. The path of the airplanes is called an *airway;* it is about ten miles wide. Every thirty or forty miles there are landing fields where the plane can land if it has to. At these fields there are usually a caretaker, telephone, gasoline, and food. There are also thirteen permanent airports on the coast-to-coast route. If the pilot gets off the course ever so little, a radio signal sounds in his ears—dot-dash, dot-dash, if he is flying too far to the right; dash-dot, dash-dot, if he is too far to the left.

When night falls, the plane keeps heading on into the darkness. The pilots are constantly talking to the people in the airports, by means of radio. Every twenty minutes the plane is expected to report to the people on the ground. The pilots receive messages about weather conditions and the positions of other planes in this way. Every ten or fifteen miles along



Gendreau

Airplane View of a Landing Field at Riverside in Southeastern California the route, flashing beacons throw beams of light into the air to guide the planes. Every third beacon has a green light to show that there is an emergency landing field there. The men who keep the beacons burning are part of the army of workers who keep the airways open.

Exciting stories come to us of the work in some of the lonely mountain stations. There is the story of the lightkeeper who clung to the top of his swaying, ice-covered tower for three long hours during a storm, to make the needed repairs that would keep his light burning for the mail plane. There was the keeper who swam two miles in a raging flood to get repairs, and there was the keeper who, when his light failed, had to dig through thirty feet of snow to get at the switches buried at the foot of his tower. Now in the places of deepest snow, the switch boxes are fastened up on the tower instead of being buried at the foot.

Among the greatest helps to the airplane pilot are the weather reports. At twenty weather stations across the country there are men whose duty it is to watch the winds and storms and send reports out to the planes. Once a day a pilot at each station flies up 17,000 feet to find out what the temperature, moisture, and pressure are at that height. Every hour the weather men send up balloons that rise into the upper currents of air. With delicate instruments they can measure the speed at which the balloons are traveling and the directions in which the winds are carrying them. At night the balloons carry lighted candles so they can be seen. It is a great help to the pilot to know that at 1000 feet up there is a west wind blowing at 30 miles an hour, while at 5000 feet there is an east wind blowing at 40 miles an hour. With knowledge of what the air is doing around him, he can choose the layer of wind which will help him on his way.

Flying today is a big business. On the map of the airways of the United States (page 182) you see how the lines of the air routes go straight from city to city. Nearly all the important cities of the country are connected in this way. We can see how helpful this is in exchanging goods and ideas quickly. There are over 50,000 miles of airways in the United States. One of our large airplane companies flies 7,000,000 miles a year—over half of it at night. Air mail goes whizzing from city to city at speeds four times as great as that of the fastest railroad train. People are learning to use the air express whenever they want goods delivered in the quickest possible time. And what is true of goods is true of people. There is nothing hard about traveling by air today. Passengers can eat and drink and move about in the roomy cabins, and there are even Pullman planes where passengers can sleep as comfortably as in their beds at home.

And now let us look at some of the principal airways of the world (see map, pages 18–19). Trace the long red line that stretches across the map from London through the south of Europe to northern Africa. On into Iraq (ē'räk'), and Persia it goes, across the northern part of India and south along the coastline till it hops across to far Australia. From the Philippines we can imagine a plane, with a roar of its four mighty engines, starting its five-hop leap of the Pacific —the hop we saw the great China Clipper make for the first time in 1935. To Guam it goes, then to Wake Island—a little coral island where no one lived before the airplane came. The next is Midway Island, the next one of the Hawaiian Islands, and finally comes the longest hop of all—the 2400 miles to San Francisco Bay. From there the routes you have already read about cross the continent, while another goes southward over Mexico and to the east coast of South America. Here the round-the-world traveler could, if he wished, complete his long journey by air by boarding the famous *Hindenburg* and crossing the Atlantic Ocean on a slow easy flight to Germany. In a few years the traveler may be able to cross the North Atlantic; even now plans for three routes across the North Atlantic are being studied, and soon more planes will make the hop.

In three weeks the traveler today can circle the globe. He can look down upon the hedgerows of England, the ruins of Athens, the pyramids of Egypt, the snowy peaks of the Himalayas (hĭ-mä'lȧ-yȧz), the hot, green jungles of Burma, the wide ranches of Australia, the Hawaiian volcanoes, and finally our own

American Rockies, the Grand Canyon of the Colorado River, and the cities and farms of our West and East. Airways today connect the important cities of the entire globe. All over the world men are planning new lines; the mapping out of the routes the planes will follow is an interesting and exciting task. Just as the pioneers in traveling westward across our country mapped out trails which later became well-traveled roads, so the pioneers of the air are mapping out trails in the sky. Their work gives us the airways of the world.

A Visit to an Airport

Have you ever visited an airport? If you have, tell the class about it. Perhaps your whole class can go to visit an airport near your school.

For Your Notebook

Write a summary of the story.

If you can get a map of the airways of the country, put it in your notebook.

Describe in your own words what a traveler might see on an airplane trip from your city to New York or Chicago or San Francisco.

For Your Museum

Make models of airplanes to show the history of aviation. Have an exhibit of them in your class museum.

11

A Fast-Moving Age

Primitive man walked slowly along on his own two feet, carrying what he had to carry on his own back or on the backs of slow-moving animals! He traveled through forests or across deserts, following simple trails. He paddled down streams on rafts of rough logs. Whatever he did was work, back-breaking work, and it took him long to get it done. The caveman age was a slow-motion age.

Men of Egypt and Greece and Rome traveled on wheeled carts that were drawn by muscle power, or ships that were driven by winds or by oarsmen. The men of the Middle Ages walked or rode over wretched roads. There were few bridges to help them over streams. Their carts sank in mud and labored up steep hillsides. The medieval way of traveling was slow and hard.

How differently things are done today! Swift trains run along their shining rails, bringing food and clothing and ideas from every part of our land. Giant ships cross the ocean at a speed so great that the waves they make would wreck the caveman's simple raft. They bring from other lands more food and more goods to make our lives richer and more comfortable. Out of the sky come roaring the winged planes that bring passengers and mail from distant cities. Instead of narrow forest paths, we have broad highways, over which there are moving, not slow-motion men with loads on their backs, but swift, shining automobiles.

Everywhere in the civilized world today machines go whizzing—machines of the earth, machines of the water, machines of the air. New ideas come with them, new acquaintances are met. This is no longer a slow-motion age. It is an age when men move easily and quickly from one corner of the earth to the next, exchanging the goods and ideas that make our ways of living possible.

Reading Time

The routes that our ships, trains, automobiles, and airplanes follow play an important part in making our ways of living. In some of the books listed earlier in this unit you will find out more about these routes. Here are more books that tell about the routes goods and passengers follow:

Baldwin, J., and Livengood, W. W., *Sailing the Seas.*
Engleman, F. E., and Salmon, Julia, *Airways.*
Starbuck, Wilson, *Liners and Freighters.*
Starbuck, Wilson, *Down the Ship's Ways.*
Theiss, Lewis E., *Guardians of the Sea.*
Van Metre, T. W., *Trains, Tracks and Travel.*
Van Metre, T. W., *Tramps and Liners.*

Tell the class the most interesting story you read about transportation. In Bush and Waddell's *How We Have Conquered Distance,* pages 89–103, there is more about the waterways of the world. On pages 103–108 of the same book you can read about the railroad systems of our country. "Airplane Routes" is the name of the story on pages 145–152.

A Study Test

Decide which phrases in Column 2 will best match the words in Column 1. Then write the eight complete sentences in your notebook.

Column 1

Robert Fulton was the
George Stephenson was the
Gottlieb Daimler was the
Wilbur Wright was the

Column 2

1. Inventor of the automobile
2. Inventor of the gasoline engine
3. Inventor of the steamboat
4. Inventor of the airplane
5. Inventor of the locomotive
6. Inventor of the steam engine

About 1803.
About 1807.
About 1895.
About 1902.

1. The steam engine was made
2. The airplane was made
3. The automobile was made
4. The locomotive was made
5. The steamboat was made
6. The gasoline engine was made

In a class discussion about each of the following statements—1 to 10 on the next page—decide whether it is true or false. Also, make a true statement to take the place of each one that is false.

Is It True that

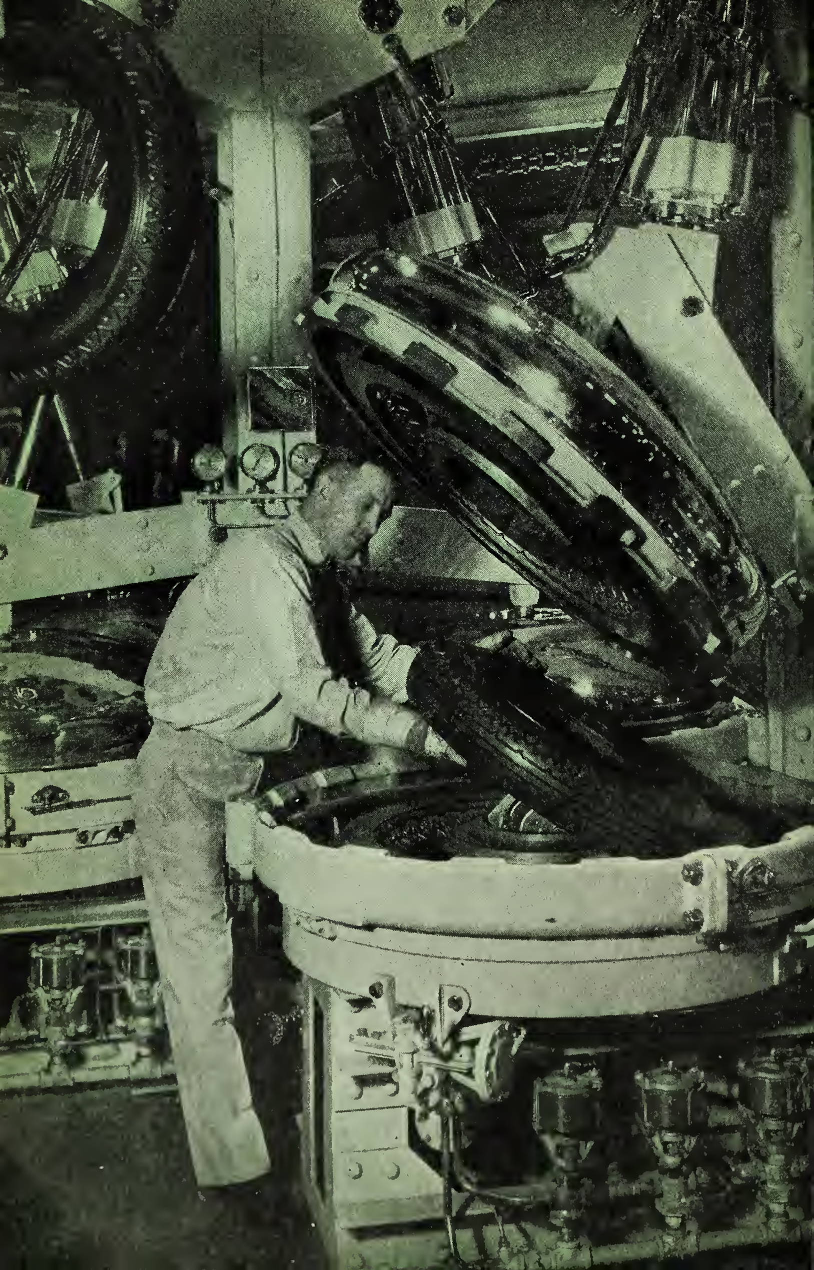
1. The most-used water route of the world runs from our eastern coast to northern Europe?
2. Canals are used mostly for transporting things which are light and which must be transported quickly?
3. There are no rivers used by large boats in Europe?
4. The first passenger and freight railroad built in the United States was the Baltimore and Ohio?
5. One can travel by train from New York to Chicago in about sixteen hours?
6. There are more than 500,000 miles of railroads in the world?
7. The Lincoln Highway runs from our Atlantic coast to our Pacific coast?
8. There were very few good automobile highways in 1900?
9. There are regular passenger airplanes flying between many large cities in the United States today?
10. The chief disadvantage of traveling by airplane is that airplanes cannot fly at night?

Talking Time

In our country more than 1,500,000 people make their living by helping transport people and goods on the railroads. What do these people do to help your ways of living? What other groups of workers are there in the United States who help transport goods and passengers?

UNIT III

MAKING GOODS WITH MACHINES



1

A Visit to Skansen

One summer Ted Nelson, an American boy who lived in Minneapolis, was visiting his cousin, Nils, in Stockholm. Stockholm is the capital of Sweden. After he had been in Stockholm about a month, Ted said at lunch one day, "I like the old part of Stockholm best. There, where the king's castle is, the streets are narrow and the buildings are old and strange. It isn't hard to imagine that people lived in them four and five hundred years ago. The new part of Stockholm has fine buildings and parks and streetcars and factories just like an American city. But not many of our cities have such interesting old parts as Stockholm has."

"If you like to see old things," said Nils, "I'll take you out to Skansen."

"What is Skansen?" asked Ted quickly.

"Skansen is a park here in Stockholm, but it is a very unusual kind of park. In it there are many small farms with old houses and barns brought there from all parts of Sweden. Some of the buildings are several hundred years old, but they are kept just as they

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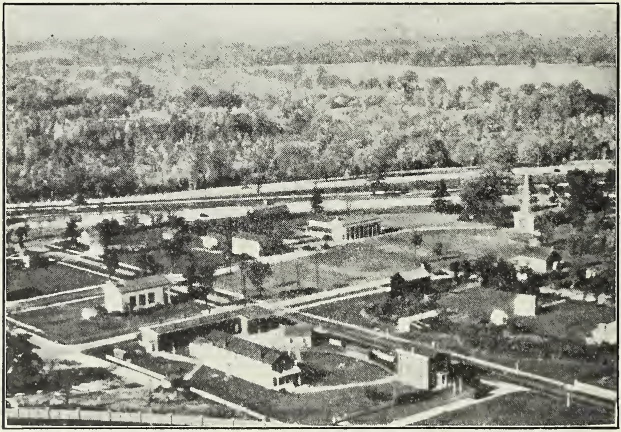
Credit: *Firestone Tire and Rubber Co.*

In making tires for automobiles much machinery is used. Here you see a tire being taken from the mold where its tread was shaped.

were in olden times. We can visit all the houses, even though there are people living in some of them. The people who are in them now wear the same kind of clothes that were worn by the people who first lived in the houses, years ago. Some of the people work in the houses, making things with the same kind of hand tools that were used by the people of long ago."

"That's a kind of museum, isn't it?" asked Ted.

"Yes, we might call it a *living museum*, for it shows how Swedes lived and worked and played long ago."



Courtesy Ford Motor Co.

In this "museum" in Michigan there may be seen the workshop of Thomas Edison, an old church, a steamboat, and many other things.

That afternoon Ted and Nils took a streetcar to the foot of the hill where Skansen Park begins. After they had handed the guard some money, equal to about five cents in United States money, they passed through the gate. As they started along the narrow path leading up the hill, they met some boys and girls, wearing old bright-colored costumes, who were driving some goats along the path. As Ted watched them, he said, "Why, it is just as if we were making a journey into olden times!" When he left Skansen several hours later he thought so more than ever.

After Ted and Nils had walked along through the Skansen woods for a while, they came to an old farmhouse. Through the open door they went into a big room which was both kitchen and living room. In the room was an old woman wearing a bright-colored apron, a kerchief over her shoulders, and a shawl over her head. Before her was a big wooden bucket full of melted tallow. She was dipping pieces of string in the tallow, over and over again, making candles.

"Hello," she said in Swedish. "I'm making candles today. This is the way candles were made when this house was new, years and years ago. No electric lights then, and no machinery for making candles, either! All this work was done by hand."

She talked with Nils and Ted for quite a while, and even let them dip some of the candles in the tallow. Each candle was made of many layers of tallow, and had to be dipped as many times as it had layers. After Ted had worked at it only a few minutes he was glad to stop. "I should not like to do that all day," he said to himself.

BAKING FLAT BREAD IN SKANSEN

After a while the boys left the house and wandered on through the woods. They found another house where a woman was making a queer kind of flat bread, like an enormous pancake. The bread was baking on a flat iron pan with a big handle, and the woman was watching it carefully. She would not let the bread burn, but she could not regulate the fireplace the way the boys' mothers regulated their modern stoves. When the bread was done she gave the boys some. It tasted very good. "But it's too bad to have to go to so much work to make bread," Ted thought.

In another old house the boys found a woman and her daughter, whose aprons and kerchiefs were just alike. They were weaving cloth. Their big loom looked very awkward. Ted wondered how anyone could keep all the threads on it straight. The cloth they were making was exactly like the aprons they were wearing, and was very beautiful. The girl told them, however, that it would take many hours to make enough cloth for even a small apron like hers. Ted and Nils decided that weaving by hand looms was as hard work as making candles by hand.

In front of another house an old man wearing a leather apron was making pans and kettles out of strips of copper. It took him so long to make even one little pan that the boys got tired and left before he had finished. In Sweden many Christmas decorations are little goats and pigs made out of straw. In one house in Skansen a man sat at a bench patiently weaving by hand the Christmas decorations out of straw. In front of a little shop in the park the boys found another old man, his tools in a little rack beside him, making shoes. In the storeroom of another house a young man was making furniture, using only a hammer and saw—not even nails.

Finally it was late afternoon and the boys had to start for home. As they ran down the hill they saw a man in a farmyard milking cows and goats. Ted wished he had time to tell the man about the milking machines he had seen in the United States. The boys ran on, however, and soon the gates of Skansen clicked behind them.

Just across the street from the park a coal truck was dumping coal into a bin. Down the street a great steam shovel was digging the basement of a new house. Automobiles were rolling along, taking people home from work. Soon the streetcar came which was to carry Nils and Ted home to dinner. As they boarded it, Nils said, "Now we're in the land of machines again. Skansen is like a land of long ago where all the work of making things had to be done by hand."

Making a Movie

Make a movie reel which will tell the story of what Ted and Nils saw in Skansen. Decide upon the number of scenes you are going to draw and paint, and let each member of the class take a part.

A Play About Skansen

Perhaps you would enjoy giving a real play about the scenes in the story. Invite the other grades of your school to see what Skansen is like.

Picture Study

Find pictures of Sweden to show your class.

On pages 220, 221 are two pictures showing how cloth was woven long ago and how it is woven now. Tell how the pictures are different. Can you find pictures for your Bulletin Board which also show how things were made long ago and now?

2

Working in a Colonial Home

"Now that Thanksgiving is past, I suppose it will be a long time before we have any fun again," sighed Abigail Pennington, as she stood by the kitchen window watching the snowflakes cover the fields and woods. "If this snow becomes very deep, it will be a long time before any one can come to our little village to bring us news," said her brother John.

"It looks very much as if we are going to have a cold, lonely winter," added Amos.

It was about two hundred years ago in Massachusetts Bay Colony that the Pennington children—Abigail, John, Ruth, Amos, and Patience—complained about the loneliness of winter in a small village. But their mother cheered them up. "If we work fast," said Goodwife Pennington, "we may be able to have all the wool carded and spun before Weaver John and Shoemaker Ethan come. I expect them here soon after the New Year."

"Oh, how glad I am that Weaver John and Shoemaker Ethan are coming again!" exclaimed Abigail. "They always tell such interesting stories about the things they have seen and done."

As Goodwife Pennington quickly mixed and cooked the corn-meal mush for supper, she said, "It surely will be pleasant to have Weaver John and Shoemaker Ethan here again. They can make shoes for all of us and weave some of the cloth we need. And we are always glad to hear the news they bring."

For many weeks everyone in the family worked hard to be ready for the annual visit of the weaver and the shoemaker. Abigail and Ruth helped their mother prepare the wool for Weaver John. They went to the storehouse and selected some of the wool that had been sheared from the sheep in the spring. After the girls had it washed carefully, Ruth used a long wooden comb to straighten out the wool. Abigail put bits of the combed wool on a card. The card was very much

The Pennington girls were glad to help their mother. What do you see in their kitchen?

like a brush with closely set teeth. Over the card she drew another card, pulling the wool through the teeth of both cards and making it light and fluffy.

Because it was winter, Goodwife Pennington had to dye the wool in the kitchen, and everyone was glad when she had finished that task and put the ill-smelling dye vats back out in the shed. Abigail was very proud when her mother gave her permission to spin the wool into thread, for her mother was very careful of the spinning wheel which had come from England many years before. Even little Patience helped to make ready for the weaver's visit, for she was big enough now to wind the finished yarn into great balls.

Goodman Pennington and the boys had started their preparations for the shoemaker many weeks earlier. Now they took the cow hides and sheep hides out of the vats where they had been soaking for many weeks and stretched them out to dry. While the mother and the girls sat by the fireside in the evenings, carding and spinning, the father and the boys cleaned and rubbed and polished the leather.

One sunny day late in January two men on horseback rode into the Pennington barnyard. Everyone welcomed the two craftsmen gladly. As soon as Weaver John came, Mrs. Pennington quickly put away all her weaving so that the weaver could use her loom. Mrs. Pennington always wove the cloth for the boys' suits and the girls' dresses and the sheets, towels, and napkins for everyday use. Weaver John had come to make some specially fine linen and to weave a beautiful coverlet of red and blue design for the great four-poster bed.

Soon the weaver and the shoemaker were busy at their work, and all the family worked with them in the large, cheery kitchen. Besides the sound of the loom and the pounding of the shoemaker, there was much talk. "Weaver John, how did the people in our colony learn to spin and weave?" asked Abigail.

Weaver John was one of the best weavers in all New England. He had come from England, where he had worked in some of the shops in London, and he knew much about the art of weaving. He said, "I do not know how long people have known how to weave, but it must have been long, long ago that people began to twist fibers into thread and invented ways of making the thread into cloth. For a very long time England has been famous for its good cloth, and the settlers in America brought the art of weaving with them from England and other lands of Europe. Weaving is mostly done in the homes here, but there are many weavers like myself who travel from village to village to weave special articles. If you were to visit the busy town of Boston, you would find shops where there are weavers as skilled as the weavers in London."

Shoemaker Ethan laid his hammer beside the pliers on his bench, and from his tool kit brought out an awl. As he punched the leather and put twine through the holes he said, "Goodman Pennington, you and your

Keystone

A SHOEMAKER who makes shoes with hand tools.

sons have prepared this leather as well as I could. Is it not a great help to us that we know how to scrape and soak and rub the hides of cattle and sheep, so that we can make leather shoes? Even today not all the people in the colony can afford to have a shoemaker come to make and mend shoes, but almost anyone can make some kind of shoes that will keep his feet dry and warm. The ways of working and the tools we inherit from our ancestors are a great help to us!"

One evening when Shoemaker Ethan was cobbling, Weaver John was weaving the beautiful coverlet, Goodwife Pennington was spinning, the boys were whittling birch splints for a new broom, and the girls were knitting stockings, Goodman Pennington brought out a little forge which he placed in the huge fireplace. The noise in the kitchen became very loud when he began to pound bits of hot iron into nails. But after a while he stopped and said, "Weaver John, tell us about some of the things you saw when you were in Boston."

Weaver John always liked to talk about such a busy place as Boston. He said, "When I was in Boston last year, I often walked about the town and marveled at the many shops and the work done in them. One day I visited the shop of a hatter, then the shop of a silversmith, and next the shop of a tailor. Goodman Pennington, if you lived in Boston, you would not have to make nails for yourself, for I saw more than one shop where nails are sold."

Goodwife Pennington rose from her place beside the spinning wheel and placed a fresh candle in the holder. "When next you go to Boston, Goodwife," remarked the weaver, "you should buy yourself a candle mold. In it you can place your twisted fibers and pour tallow and make six or more candles at a time."

"What a wonderful help a candle mold would be!" exclaimed the Goodwife. "Every fall I dread candle-making, for it takes much time and work to hang twisted fiber on a rod and dip it time after time until the candles are thick enough to make a good light."

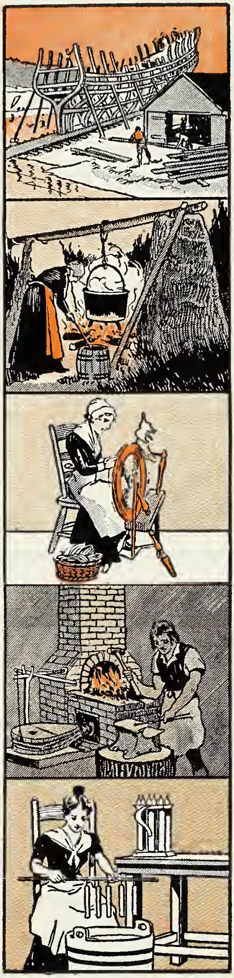
As Shoemaker Ethan brushed and polished with pride and care a pair of shoes he had just finished for

Abigail, Amos asked, "Weaver John, what other shops of craftsmen did you visit in Boston?"

"You would enjoy the shops of the curriers, the saddle makers, the harness makers, and other workers in leather that I visited there," replied the weaver. "I went to several shoemakers' shops, also, though it is said that the largest shoemakers' shops in the colony are in Lynn, several miles north of Boston."

Amos had another question. "Weaver John, did you chance to visit the ropewalk in Boston?" he asked.

"Yes, my good lad, and what a sight it is! The rope is made by hand. One end of a piece of rope is tied to a peg, and then for more than a thousand feet the workers walk slowly away from it weaving the strands of hemp together as they go."



Among the many kinds of work done in colonial times were those shown here: shipbuilding, soap making, spinning, nail making, and candle making.

When Goodwife Pennington finished her work at the spinning wheel, she went to the long table in the center of the kitchen. As she took yeast from an earthen jar and began to set dough for the morrow's baking, she said, "The wonderful shops in Boston and New York and Philadelphia and Charleston must be a great help to the people who can go to them and buy the things they need. But most of us who live in the colonies must make the things we use. We should all be grateful for the knowledge, tools, and skillful hands that help to make the many things we need."

Making Candles

Perhaps some member of your class can bring a candle mold to school. You would enjoy making some candles of wax and painting them in bright colors.

A Summary

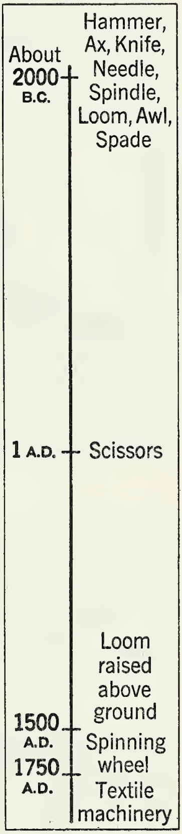
Write a summary of the way cloth and shoes were made in colonial times.

Things to Talk About

Find out more about the ropewalk in Boston to tell the class. Which work of colonial times would you have liked best? Which would you have liked least?

3

The Tool Time Line



The time line here shows us that for thousands of years man used simple hand tools to help him make the things he needed. Before 2000 B.C. man was using the simple tools you see at the top of the time line. Farther along on the time line you see some of the improvements he made in his hand tools.

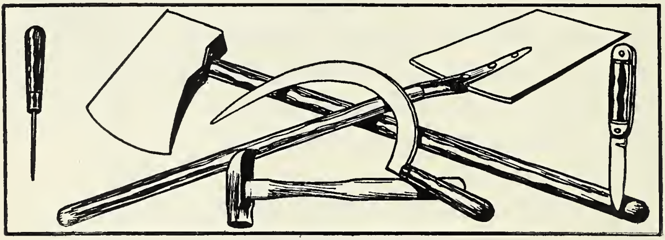
The kind of loom Weaver John wove the coverlet on was very much like the loom used all through the Middle Ages. It was sturdily built and raised above the ground, but otherwise it was not much different from the looms used before men could write.

The kind of spinning wheel that Goodwife Pennington used had a foot treadle, an improvement which came to Europe about 1600.

After 1750 factories were started where goods are made by machines. Soon handwork in the home became less important than it was before. Machines have taken the place of slow handwork done with the help of simple tools.

Your Museum

Make as many models as you can of hand tools used in colonial times. Here are pictures of some of the tools. What were they used for?



The Tool Time Line

Copy the tool time line into your notebook.

A Frieze

On a large piece of wrapping paper make a time line for a picture border for your classroom. Draw on it pictures of tools and machines. Can you add to it some other inventions of machines since 1750?

Reading Time

In your school and in the library you can find many books that tell how people lived in the days when most things were made by hand with the help of simple tools. Here are some books that tell stories about workers who made things by hand:

Bailey, Carolyn Sherwin, *Children of the Handcrafts.*
Bailey, Carolyn Sherwin, *When Grandfather Was a Boy.*
Gibson, Katherine, *The Goldsmith of Florence.*
MacElroy, Mary H., *Work and Play in Colonial Days.*
Stone, G. L., and Fickett, M. G., *Everyday Life in the Colonies.*
Tillinghast, L. Morton, and Colman, E. M., *Colonial Life in America.*
Unit Study Books, No. 503: *Colonial Life.*
Waddell, John F., and Perry, Amy, *Long Ago.*

Talking Time

During "Talking Time" ask your teacher to read you some of the stories from Carolyn Sherwin Bailey's *Children of the Handcrafts.* There are stories of girls who made samplers, quilts, and hats; of boys who helped make furniture, wagons, books, clocks, silverware, and other things by hand.

You may want to read again the stories of "Making Goods with Hand Tools" in Unit V of *Where Our Ways of Living Come From.* In that book, also, look on pages 335 and 377–378 for names of books that tell about the way people made things before the age of machines; and see, for example, pages 43–75 of Burns's *Stories of Shepherd Life.*

Look in the Table of Contents and the Index of books on colonial life for other stories of the way people made things in those days.

James Hargreaves is watching and playing with his wife's spinning wheel. Can you guess why?

4

The Spinning Jenny, a Machine

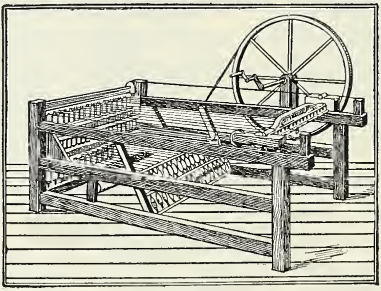
Crash! went the spinning wheel on the floor. Goodwife Hargreaves had just given a good strong push to make the wheel turn fast, when one of her children bumped against it. Over it went, the wheel still turning around. Just then James Hargreaves, her husband, came in at the door. For a moment he stood and watched the spinning wheel. Then he did a very strange thing. The children could scarcely believe their eyes, for he sat down on the floor beside the spinning wheel which was still turning, and began to play with it.

James Hargreaves and his family lived in a small house in Stanhill, England, in the year 1764. He was a spinner by trade, and every day his wife and children helped him spin thread. It was very slow and tiresome work. Although for many years spinning wheels had been used, the pulling and shaping of the threads was still done by hand. Each spinner could spin only one thread at a time, and it took eight spinning wheels to supply one weaver with enough thread to keep him busy at his loom.

Many times James Hargreaves had tried to think of some way to make his work easier by spinning two threads on one wheel at the same time. In fact he had made a spinning wheel with two spindles, as the rods on which the thread was twisted and wound were called, but he could not make it work well.

Now on this day as he sat beside the fallen spinning wheel, he saw at last how it could be done. The sight of the fallen wheel had given him the idea he was searching for.

When Hargreaves and other experimenters had tried to make the wheel turn two spindles it had been in an upright position and the threads sagged and tangled. As Hargreaves watched the wheel turning on the floor he suddenly thought, "With the wheel lying on its side, it might turn several spindles at the same time without tangling the thread." As a result of his idea he soon built a spinning machine with eight spindles working at the same time. He called his machine a "spinning jenny"—after his wife's name, it is said.



A Hargreaves Spinning Jenny. This picture shows a later form of Hargreaves's invention—not the first one.

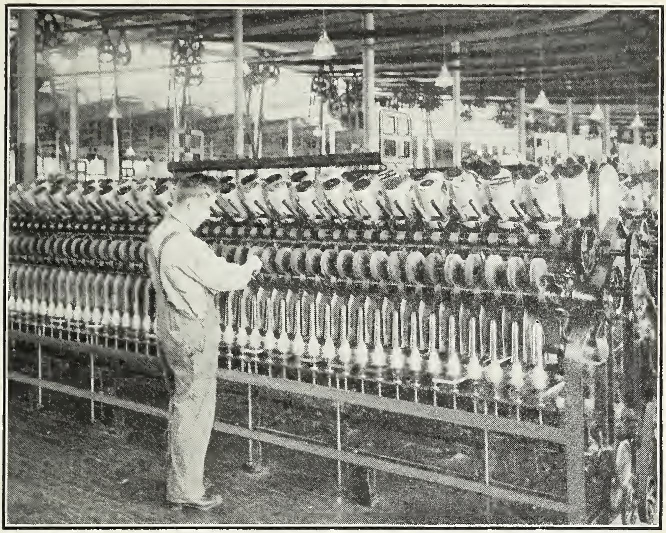
James Hargreaves had done a wonderful thing. His machine did the work of eight persons. Now one spinner could keep up with a weaver. It was much easier for the spinners, too. Hand spinning had to be done with great care. There were several different things to watch at the same time. The handfuls of fiber had to be pulled out of the wool or cotton just so and shaped just right, and fed to the spindle at just the proper speed. All this time, the wheel had to be kept going. Of course, the "spinning jenny" had to be tended carefully, too, but it did much of the work by itself. It saved the spinners much time and much hard work.

We might expect that the spinners would be thankful to Hargreaves for his clever invention, but they were not. Instead, most of them were very angry and did not like the new machine. They said that it would spin thread so quickly that there would not be enough work left for them to earn their living. One day a few months later the Hargreaves children heard a great noise in the street outside their home. They ran to the door and saw a crowd of angry spinners who cried that the new machine would take away their earnings and their bread. James Hargreaves shut the door and bolted it. But the angry spinners battered it down and rushed into the house. They broke the "spinning jenny" into pieces and threw them out into the street. Hargreaves and his family had to flee to another town to save their lives.

James Hargreaves had lost his precious "spinning jenny," but he was not to be discouraged. Before long he made another one which worked even better. Soon afterwards he found out how to make one with sixteen spindles instead of eight (picture on page 214). There was no longer any doubt that spinning machines could be made to take the place of the old hand tools for spinning.

For many centuries before James Hargreaves lived, people had known how to twist wool or flax into thread, and then to weave the thread into cloth. But always the work had been done by hand—slowly, with patience, and with aching muscles. Now an invention had changed the way of spinning—had quickened it and made the work less tiring. The new invention is called a *machine* rather than a hand tool, for it made metal and wood do the work of muscles, and could be run by power from animals or waterfalls or steam, or, later, electricity and gasoline engines. Today, if you go to a spinning mill you can see huge machines with hundreds and even thousands of spindles which spin quickly and cheaply the thread that is to be woven into cloth.

The invention of the spinning jenny was the first of a long line of inventions which changed men's ways of making, not only cloth, but most of the other things they use. On the day that Hargreaves built his first spinning jenny, making one machine do the work of eight people using hand tools, we may say that the



Publishers' Photo Service

SPINNING FRAME in a modern woolen mill in New England. How do the machines compare with the early Hargreaves jenny?

"age of machines" had begun. We live in the "age of machines"; without machines we could not have the things we have, or do the things we do.

In the stories which follow you will read about other inventors who did more to help machinery take the place of the slow hand tools. But we should remember that many of the inventions were made possible because James Hargreaves found out how to make his spinning jenny. It was a lucky accident that he saw his wife's spinning wheel turning around after it crashed on the floor.

A Class Visit

If there is a weaving factory in your community, perhaps your teacher will take you to visit it.

Drawing Time

Draw a picture of a spinning wheel and of a hand loom.

Things to Talk About

Why was spinning so much slower work than weaving?

Why did not the other spinners like Hargreaves's invention?

Would the invention of the spinning jenny help to make cloth cheaper or more expensive?

If you have seen a real spinning wheel, describe it for the class.

For Your Museum

Make a model of a spinning wheel.

5

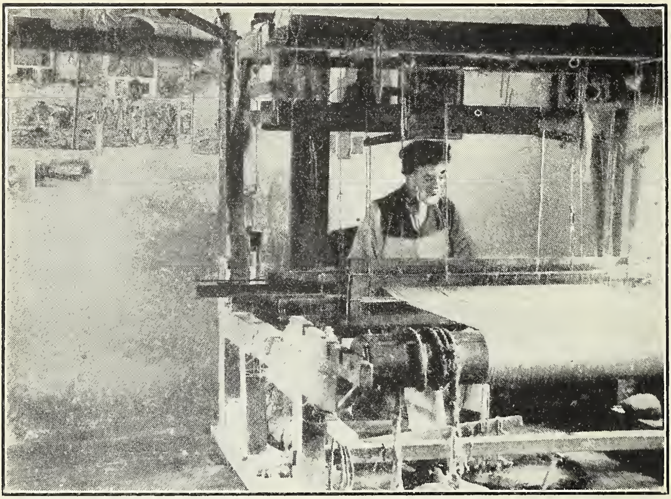
The Power Loom

Edmund Cartwright stood in the doorway of the spinning mill and frowned. He had reason to frown, for he was being laughed at—and by the owner of the mill.

Cartwright was visiting the mill of Richard Arkwright. In the mill were many machines for spinning thread. Cartwright had never before seen a spinning machine run by power. As he watched the finished thread come swiftly out of the machines, he thought, "What a pity it is that all that thread has to be woven into cloth slowly by hand. If machines could be made to weave the cloth rapidly, we could use up all the thread Arkwright's machines can spin." Eagerly he turned to the mill owner with his idea, but to his surprise a smile was his only answer.

"But why is it not a good idea?" insisted Cartwright. "Why cannot we make steam or water power run the looms as well as the spinning jennies? If machines can help you to spin, they can also help the weavers to weave." But Arkwright shook his head.

"No, no, my dear sir!" he exclaimed, laughing. "It cannot be done. Weaving must be done on hand looms, and not by machines driven with power. I have made cloth long enough to know that. Such a machine

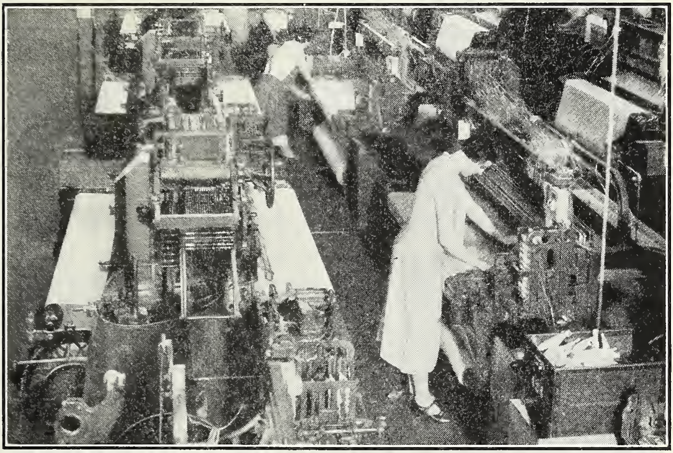


Weaving with a Hand Loom. Is much weaving done in this way today?

would have been invented years ago if there had been any possible way of doing it. Come, there is yet more in my mill that I would show you." And Arkwright led his frowning visitor away from the machines.

But Cartwright could not forget his idea. He had liked Arkwright's spinning mill. He knew that before spinning machines were invented in 1764 it took eight spinners to keep one weaver supplied with thread. Now, in the 1780's, the spinners were producing more thread than the weavers could use.

Cartwright went home and thought about the problem. He drew plans on paper. He made models. Then he called in a blacksmith and had a talk with him. The blacksmith scratched his head and looked doubtful, but soon, under Cartwright's direction, he was hard at work. By 1785 they had made a loom worked by water power instead of man's muscles. Cartwright was pleased with his invention. It was his turn to smile. His loom wove cloth more rapidly than it could be woven by hand. The new loom was worked by power supplied from a waterwheel or from a steam engine. When he built a factory for his new looms, the weavers burned it, because they feared the machines would put them out of work. The inventor, however, was not discouraged. He soon built other



Ewing Galloway

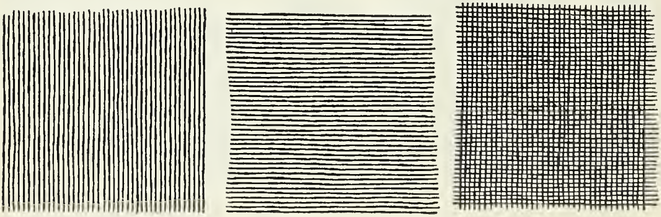
WEAVING WITH POWER LOOMS in a factory in New Jersey. Compare this picture with the one on the opposite page.

factories, and power looms were used more and more widely. Cartwright tried other inventions, too, among them a machine for carding or combing wool, which worked so well that someone wrote this verse about it:

> Come, all ye Master Combers, and hear of
>   our Big Ben.
> He'll comb more wool in one day than fifty
>   of your men
> With their hand combs and comb pots and such
>   old-fashioned ways;
> There'll be no more occasion for old Bishop
>   Blaize.

Bishop Blaize was the patron saint of the men who combed wool by hand.

In order to understand what a wonderful thing it was to have a power loom for weaving cloth, we must recall a little about the way cloth is made. Weaving is one of the very earliest of industries. Long ago men learned how to twist the fibers of sheep's wool, or the fibers from plants such as flax, into threads that could



Warp Threads and Weft Threads woven together.

be woven into cloth. The ancient Egyptians used linen cloth made very much as cloth is made today, by crossing, or weaving, two sets of threads.

When a weaver makes cloth he fastens many long threads, called the *warp*, lengthwise on a frame called a *loom*. Then he passes other threads, called the *weft*, crosswise over and under the warp threads. This makes a very simple pattern in the cloth. With the hand loom it was hard to change the simple pattern, but with the power loom it was easier to weave different patterns in the cloth.

Once it had been proved that weaving could be done by machine, other inventions came thick and fast. All sorts of new ideas were tried, until today the weavers are able to make cloth that is alike on both sides, and cloth that is different on the two sides. They can change the angle of the crossing threads, and braid, or plait, cloth instead of weaving it at right angles. They can make netting in which the threads are tied with knots. They can even knit cloth by means of a series of loops, and make beautiful lace by passing one set of threads between and around a second set of threads. The power loom, too, can use new materials that the hand loom could not use—materials from animals, such as hair and fur, skin and feathers; materials from metals, such as gold, silver, copper, and iron; even materials such as paper and glass. Out of all these, cloth can be made today, although the most-used materials are still wool, cotton, silk, and flax.

It is easy to see that the machines for weaving cannot be so small and simple as the old hand looms. The power loom and all the machinery that has followed it can no longer be kept in a worker's home as the old hand loom once was. Factories are needed where the heavy machines can be cared for and where the expense of running them can be shared by many men. No one man could run all the machines. In the factories workers learn to do one thing and do it well. Each has his share in the making of cloth. While great machines work busily today, beautiful cloth for our use is made more rapidly and cheaply than it was ever made before.

Working Together

Let the whole class together work out a summary of the story of Cartwright's invention. Have one pupil write it on the board. Then copy it in your notebook.

Weaving

Do you know how to weave? Weave some mats of paper or of yarn to show which are the warp threads and which are the weft threads.

Tell the Class

Perhaps some members of the class have visited a factory where cloth is made. Ask them to describe the machines they saw.

6

Eli Whitney's New Machine

"I think I shall plant more cotton this year," said Mr. Henry to his friend John Fitzwilliam one morning in the spring of 1792.

"If what I hear about that Yankee inventor at Mrs. Greene's is true," replied his friend, "I, too, shall plant more cotton. There ought to be a large profit in it. My land is better suited for cotton than for rice."

"It's true all right," answered Mr. Henry. "I've talked with planters who know that the young Yankee at Mrs. Greene's is working on a machine to separate the seed from the cotton fiber quickly. They call it the cotton gin."

"Think what it will mean to us!" exclaimed the other planter. "It now takes a slave a whole day to take the seeds out of one pound of cotton. People say that this cotton gin will clean fifty pounds in a day."

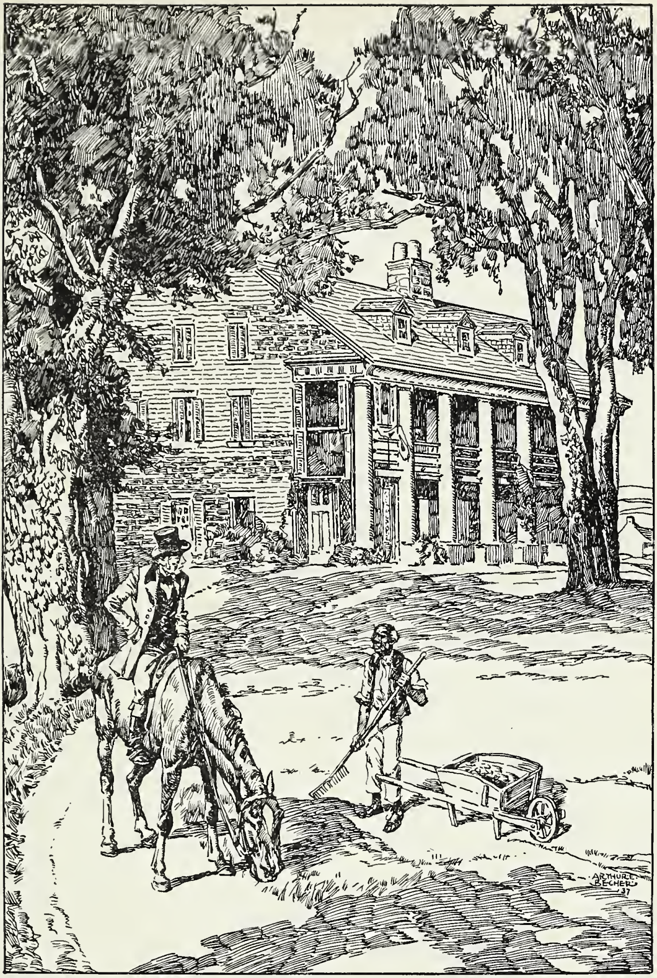
The two planters stood on the broad white porch of Mr. Henry's home near Savannah, Georgia, looking out over the rich fields of his plantation. And they did not know even then that they were talking about one of the most important inventions ever made by an American.

Eli Whitney, for that was the Yankee's name, was a young schoolteacher who had come to Savannah from the North. He was born in Massachusetts on December 8, 1765, only a year after Hargreaves had invented his spinning jenny in England.

As a boy Whitney liked to use tools and make things in the farm workshop, rather than work in his father's fields. When he was sixteen years old he persuaded his father to give him the tools to make nails. At this time nails were very scarce. They were made by hand and cost a good deal. Before long young Eli was supplying all his neighbors for miles around with nails. He was very skillful, too, at making long wire pins which were used by ladies to fasten on their bonnets.

When Whitney was twenty-four his father agreed to give him the money for a college education if he would pay it back. So he entered Yale College and graduated in 1792. Then he went south, to become a tutor in a private family, but when he reached there, he found his position was already filled. On the boat to Savannah he met Mrs. Nathanael Greene, the widow of General Greene. When she heard of his misfortune she invited him to come to her plantation, some twelve miles from the city.

While he was there his skillful fingers made and repaired toys for the Greene children. One evening while Mrs. Greene was embroidering on a frame called a tambour, she said that the frame tore the silk threads of her work. Whitney asked her to let him study the frame, and a few evenings later he gave her a new frame that would do the same work but was made in



A SOUTHERN PLANTATION HOME. Some Southern planters had very fine houses.

a different way. It was so much better than the old one that she was delighted with it and wanted to know where he got it. To her surprise he replied, "Oh, I just got it out of my head."

One evening a group of planters were visiting at the Greene home. In their talk some of them said they hoped that some day a machine would be invented to do the slow, tiresome work of picking the seeds from cotton.

"Gentlemen," said Mrs. Greene, "why don't you talk to my young friend Mr. Whitney about such a machine? He can make anything."

Whitney was called in, but when he learned what the planters wanted, he told them he had never even seen cotton fiber, and did not know how to make such a machine. However, the very next day he went to Savannah to get some seed cotton and he set to work to solve the problem.

Mrs. Greene encouraged him in his work and gave him a room in the basement of her house for his workshop. He shut himself up with his task and was heard early and late hammering, sawing, and filing. No one was admitted to the room but Mrs. Greene and Phineas Miller, the tutor of Mrs. Greene's children. At the beginning Whitney had neither good tools nor enough money. An old college friend supplied him with money, but the tools he made for himself.

In Asia and the West Indies at this time there was a roller gin used to clean the long-fibered black-seed cotton. This roller gin would not clean the green-seed cotton raised in Georgia, which has a short fiber and small seeds firmly attached. Whitney, however, did get some valuable suggestions from one of the West Indian machines which a neighboring planter had tried to use. His first successful cotton engine, or gin, had a box to hold the raw cotton. Iron bars placed close together in pairs formed one side of the box, or hopper, and heavy boards the other sides. Reaching well up into the hopper was a wooden cylinder armed with rows of wire teeth. When the cylinder turned, the short wire teeth grabbed small bunches of cotton and pulled them through the slits between the iron bars. Thus the fibers were torn from the seeds. Brushes then swept the cotton from the wire teeth.

The part of the machine which gave Whitney the most trouble was the teeth of the cylinder. He wanted to use teeth like the teeth of a circular saw, but he had at hand no iron plates thin and strong enough to make them. Fortunately at this time there arrived at Mrs. Greene's a coil of heavy wire bought to make a bird cage. Then Whitney thought of making wire teeth for his machine. However, the wire was too large and had to be drawn smaller with Whitney's crude tools. But he was an expert, for had he not drawn wire to make hundreds of bonnet pins? He finally succeeded in making wire teeth that were narrower than the seeds and would not greatly injure the cotton fiber.

This picture shows Eli Whitney explaining his first cotton gin to some planters and merchants.

Unfortunately every little while the teeth would become clogged. It was hard work to get the cotton off them. One day Mrs. Greene saw Whitney working away cleaning the clogged teeth.

"Why don't you clean the cotton off this way?" she asked, and she began to brush the teeth with a hearth brush.

"Just the thing!" exclaimed Whitney, and he set up a brush that turned around just back of the cylinder.

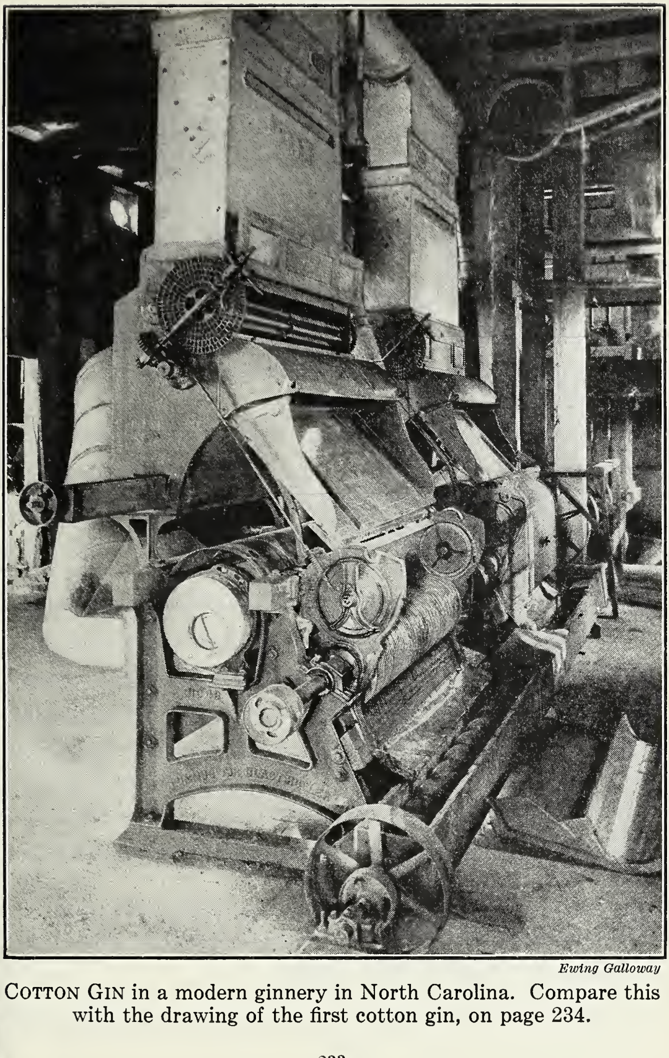
About the end of the winter, in 1793, Whitney finished his first machine. Mrs. Greene invited a group of planters and merchants to see it work. They looked on in amazement and saw that with this little machine one man could separate as much cotton from the seed in one day as he could separate by hand in a whole winter. With this gin, the cotton grown on a large plantation could be cleaned in a few days. By hand the cleaning would take a hundred workmen several weeks.

The planters saw that with this gin to take out the seeds, they could now raise cotton at a good profit. They were so delighted that they could not keep such a secret to themselves. Before long the news was all over Georgia. Crowds came to see it, but the unfinished machine had not yet been patented, so they were not allowed to view it.

When a man invents a machine, he usually has thought out some very clever ideas that no one else has figured out before. This is really what inventing a machine means. Often the inventor is a poor man, as Whitney was, who has no money to buy the materials and no factory in which to make his machines. He must first show his machine and get men who have money to help him start a factory. To do this he has to show his new invention to a great many different people. Sometimes these people are dishonest enough to copy the inventor's machine and begin making it in a factory of their own, without giving the inventor any share of the profits. To prevent such unfair treatment of the inventor, the United States government will give the inventor a *patent* which protects him by not allowing any other manufacturers to make the same machine.

Whitney's machine was not yet patented, and he guarded it carefully. But one night the shed in which it was kept was broken open and the machine was carried away. Whitney was in despair over his great loss. Soon many machines similar to his were in use. He had to begin a long struggle with manufacturers who made copies of his "cotton gin" and sold them. It was a long time before he was able to prove in court that he was the real inventor and to get his machine patented.

Up to the time of Eli Whitney cotton cloth was very expensive, and most people could not afford to wear it. Although machines for spinning threads and weaving cloth had been invented, cotton had cost so much to clean that it was cheaper to use wool or flax.



Ewing Galloway

Cotton Gin in a modern ginnery in North Carolina. Compare this with the drawing of the first cotton gin, on page 234.

And even the cloth made from wool or flax cost so much that common people could not afford to have many clothes. After the invention of the cotton gin, however, cotton became so cheap that nearly everyone could afford to have new clothes made of cotton cloth.

Acting Time

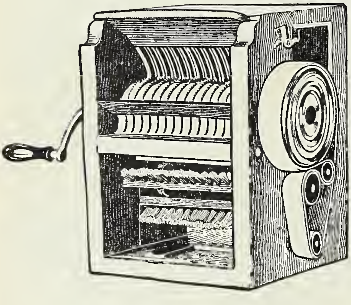
The story of Eli Whitney and his invention would make a good play. Act it in the classroom.

A Summary

Write a summary of how the cotton gin came to be invented.

Model for the Museum

Make a model of how you think the cotton gin looked. The picture here shows such a model.



Look on the machines used in your home for the word "Patent" or "Patent Applied For." What do these words mean?

7

The Sewing Machine

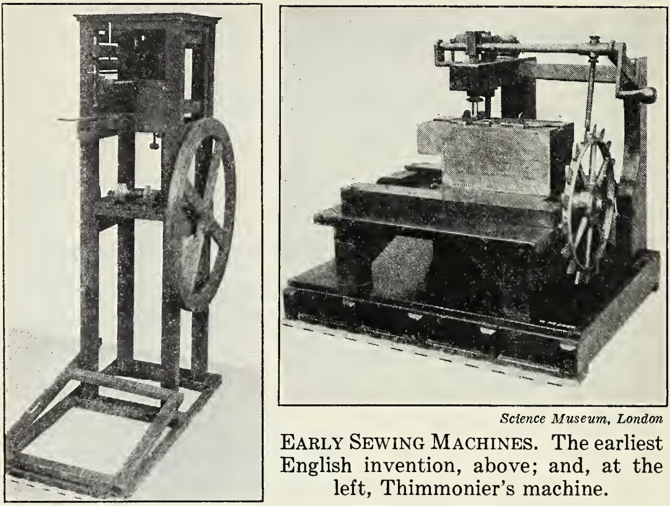
François (fräɴ-swä′) and Marie (må-rē′) were children in Paris over a hundred years ago. Their parents were very poor, and earned a living by sewing at home. Each morning François's father went to a French army post and brought home a great bundle of cloth to be made into uniforms for the French soldiers. Then the whole family worked all day long. Father arranged the patterns and cut the cloth; Mother sewed without rising from her chair until it was time to prepare the meals. Marie threaded needles for her mother and helped her in other ways. François held the paper patterns on the cloth while his father cut. The family had worked at home for years in this way, ever since François and Marie were very little. But one day the father came home from the army post and said that he was going to work the next day in a factory.

"In a factory!" exclaimed the mother. "What kind of work is it?" she asked with some alarm.

"The same work that we are doing here," said the father.

"Then why do the work in a factory? It is more pleasant here with all of us working together."

"Yes, but in the factory they have a machine to sew with."



Science Museum, London

EARLY SEWING MACHINES. The earliest English invention, above; and, at the left, Thimmonier's machine.

"A machine? What are you trying to tell me?"

"Yes, Mr. Thimmonier (tē-mȯ-nyā′) has invented a machine that will sew the pieces of cloth together. It sews much faster than we can."

"Do you know how to run the machine?"

"Oh, that is very easy. Mr. Thimmonier showed me how. You put the pieces of cloth together at the edge to be sewed, and push them over a little flat plate. A needle comes down and makes the stitches."

"But what shall *we* do? Shall you bring no more work home for us to do here?"

"Oh yes, there will be plenty for you. The machine can sew only the long seams that run straight."

So the family kept on with their work, finishing the garments that came partly sewed from the factory. François and Marie liked to hear about the new machine. They never tired of hearing Father tell how fast it could sew, and that a day's work by machine was a whole cartload of garments instead of the armful that could be sewed by hand. He told of more machines being put in the factory, with improvements so that more of the sewing was done by machine.

"Ah!" sighed the mother, "soon there will be no work to be done at home. What shall we do then?"

She was not the only one who wondered. Many people were talking and complaining about the sewing machines. They did not like the new way of making clothes. They did not like the factory which was putting in more machines every month. "The factory will take the work out of our homes," protested a neighbor. "Yes, and the bread out of our mouths," another agreed.

One day François's father suddenly appeared in the open doorway of his house, long before closing time at the factory. He had been running and was out of breath. His handkerchief was tied around his head.

"Oh, papa!" cried François and Marie and their mother. "What has happened? Are you hurt?"

"The mob has wrecked the factory," the father began as soon as he got his breath. "They threw stones through the windows and broke down the doors. One stone struck my head."

"Was anybody badly hurt?"

"I don't think so," the father replied. "We all ran for our lives. They were smashing up the machines."

"Who started it all?" the mother inquired.

"Oh, our neighbor Villard (vē-yär′) was the leader as usual. He stood upon a cart in the street and made a speech in front of the factory. We could hear his voice above the noise of our sewing machines. 'Let us save our homes and our bread!' he shouted, and then he led the attack on the factory."

The inventor of the machines fled from the city. He did not try to make any more sewing machines, because he feared that if he did, another mob would break in and destroy them. For many years no more sewing was done by machines in Paris. The workers sewed in their homes as they had done ever since any one could remember.

As you read the stories of other important inventions you will find that several of them are like the story of the sewing machine. In each one, the same things happen in about the same order. First, some clever mind invents a machine to save work by hand or to do much more work in less time. The machines are placed in a factory. A few workers who run the machines like them and are satisfied or even delighted with the new way of making goods. But the home workers do not like the machines, and it is easy for their leaders to arouse them to "save their homes and their bread" by destroying the machines. When you read such stories, remember François and Marie and what happened to the first sewing machines in Paris. Sometimes it took many years before the inventors could protect their machines long enough to prove that they were better than the older ways.

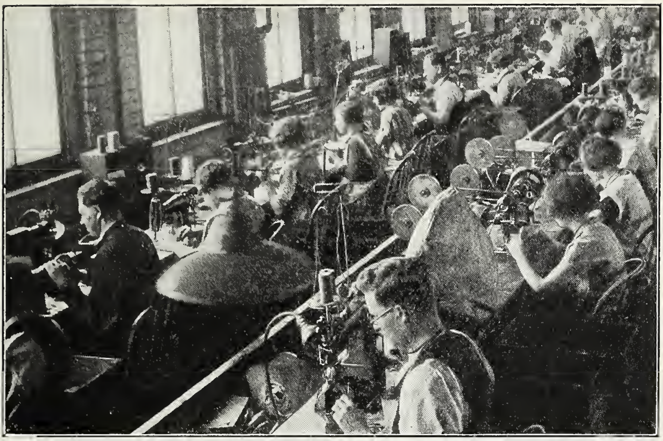
Shortly after Thimmonier made his sewing machines in Paris, Walter Hunt, in New York, invented a sewing machine. His machine had an eye in the point of the needle to carry the thread through the pieces of cloth which were sewed together. His machine, however, was never very successful. In 1846 Elias Howe of Spencer, Massachusetts, patented another sewing machine which was really the ancestor of our sewing machines of today. The advantage of the machine

HOWE'S SEWING MACHINE. To prove the value of his machine, there was a contest between it and a group of women sewing by hand. The machine sewed more than they did.

was that it could make a great many stitches very fast, ever so much faster than the most nimble fingers of the hand sewers. Today sewing machines can make as many as 20,000 stitches in a minute.

Nobody tried to destroy Howe's sewing machine, but he had a lifelong struggle with his patents, as Whitney had had. He was very poor and his wife was ill. It takes a good deal of money to manufacture enough machines to sell. A rich friend had lent Howe money to get his machine patented. But even when Howe showed that his machine could sew very well, nobody at first was interested enough to start manufacturing the machines. Then Howe went to England and succeeded in getting a patent there. Manufacturers at last began to make and sell his invention. Then a new misfortune overtook him. The manufacturers did not keep their promise to pay him his share of the profits, and others made machines like it and sold them, paying no attention to Howe's patent. Only after many years of fighting in the law courts did he finally succeed in getting his rights and the money which his invention earned.

Other inventors improved the sewing machine in several ways. One improvement, made by John Bachelder in 1849, pushed the cloth through the machine instead of having the sewer push it through by hand. Another improvement was made by Isaac Singer in 1851, a foot treadle to run the machine, leaving the sewer with both hands free to guide the cloth. Today



Gendreau

SEWING MACHINES that do part of the work in a modern factory.

many sewing machines are run by electricity. Even in sewing, machines have taken the place of hand tools for most purposes.

Acting Time

This is another story from which to make a play. After you have decided who shall play the parts, write the dialogue for them. Then write an "epilogue" or summary of what happened later to the invention of sewing machines, to be read at the end of the play.

New Words

Be sure that you know the meaning of *inventor, invention, tool, machine, manufacture,* and *factory.*

8

Button Machines

> "Rich man, poor man, beggar man, thief,
> Doctor, lawyer, merchant, chief."

Did you ever play this game as you counted the buttons on your dress or coat? Almost all our clothes today have buttons on them to hold them together or to make them look pretty. If you had lived one hundred fifty years ago you could not have afforded to have many buttons on your clothes. They were too expensive for most people to buy. At that time all buttons had to be carved by hand, slowly and carefully, one at a time.

You have been reading stories about the way machines have taken the place of handwork. The stories about making thread and cloth show how machines took the place of hand tools. The story of buttons is another interesting example of the same thing.

Buttons were worn in ancient times. The Greeks and the Romans had buttons on their clothes. Skillful hand workers among the Greeks and Romans made beautiful buttons of precious metals with jewels in them. They were used, however, only as ornaments or decorations, and not to hold their clothes together. There were buttons, but no buttonholes. You may think it strange that the Greeks and Romans did not

The Romans wore long flowing robes called *togas*, which did not need to be buttoned.

need buttons to fasten their long flowing robes; but they used girdles for that purpose.

The word *button* at first meant "bud" or "knob." The people of ancient times who could afford to buy handmade jeweled knobs, probably liked to wear them for the same reasons that people like to wear jewelry today. But the important thing to remember is that the buttons were expensive because they were made by hand, and the craftsmen who made them were artists. The button makers spent many hours making the beautiful designs for the buttons, and then many, many more hours carefully carving and shaping them.

All through the Middle Ages at the courts of the kings and queens the rich people wore buttons as a part of their jewelry. Collecting buttons was one of the hobbies of King Louis XIV of France. He spent thousands of dollars for beautiful buttons.

About four hundred years ago people began to use buttons and buttonholes to hold their clothes together. Then they began to make buttons of cheaper materials. They used bone, hard wood, shell and brass and other cheap metals. These buttons were still made by hand. They did not cost so much as the gold and silver buttons of the people of ancient times or of the Middle Ages. They were still expensive, however, because they were carved or molded slowly by patient hand labor, one button at a time.

About one hundred fifty years ago there was a button maker named Benjamin Randolph. He worked by hand in a little shop on Chestnut Street in Philadelphia. He printed notices or advertisements saying that he made "buttons of apple, holly, and laurel wood, hard and clear." It took him a long time to carve a button. Perhaps he went out into the woods and picked out the wood himself. Then he took it to his shop and cut out the buttons with a few hand tools. He had to have very sharp knives for carving the buttons.

In the year 1807, when people were beginning to invent machines to take the place of hand labor, a man named Saunders invented a machine to make buttons. His machine cut out little round pieces of wood and metal. These pieces were covered with silk or other cloth. His invention was the first machine to take the place of handwork in making buttons.

Since then machines have continued to take the place of handwork, until now almost all the buttons made in the world are made by machines. Machines can make buttons so quickly and easily that today most buttons are very cheap. All of us can afford to wear them. In the factories where buttons are made, drills and saws cut the bones, shells, and other materials into the proper shape. Punches make the holes in the buttons. Special machines bend wire into a little loop, and others fasten this loop on the under side of some buttons so that it can be sewed to a dress or coat.

Some buttons are made by machines which stamp the design in pieces of soft material which later hardens. These stamping machines are called *dies*. They cut and stamp designs and patterns in wood and metals. There are also special molding machines for making glass buttons. Many special kinds of work are required to make all the different buttons we have today. There are even machines which sew the buttons on the cards you see when you buy buttons at the store.

The story of buttons tells us about a great change in our ways of living. From ancient times down to your great-grandmother's day there were no button machines at all. All buttons were made by hand labor. They cost so much that only the rich could wear them.

The great change that has taken place in our ways of living is that rapid machines have taken the place of slow hand labor. It is the same sort of change that you read about in the stories that told of the making of thread and cloth and the sewing of garments. Are you not glad that you live in the time of machines that can make cloth and buttons so cheaply that we can all afford to wear them?

Talking Time

Tell to the class the story of how the buttons on your clothes were probably made.

For Your Museum

Make a collection of different kinds of buttons. Arrange them to show which buttons were made by hand and which by machines. Perhaps the boys can carve by hand some old-fashioned-looking buttons.

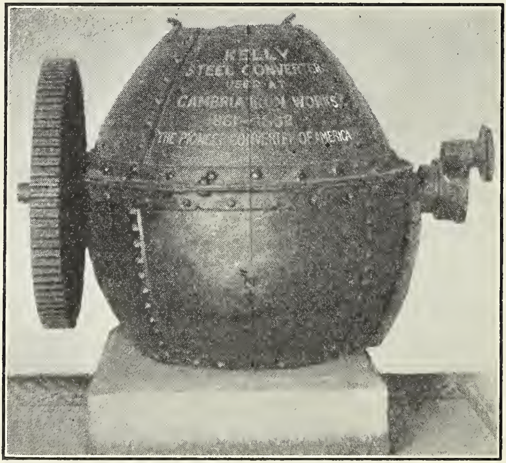
9

The Age of Steel

Many machines, and the steam engines to run machines, were at first made out of iron. There was one thing that men needed above all else if they were going to improve their machines and engines. That was good, cheap steel. Even before men could write they could heat iron ore and make iron in small amounts. In the Middle Ages ironworkers learned to make their furnaces higher, and could make more iron than men could make in ancient times. The knights of the Middle Ages needed good armor and swords, and the ironworkers were very important in helping to make the ways of living in the days of the knights. By reheating and hammering iron time after time, these skillful workers were able to make fine steel swords, such as were carried by King Richard of England and other great warriors.

In all the years that passed, no one found a quick way of making steel, which is iron made very hard and strong. In colonial times in our own country, and in Europe, there were many small furnaces where men made iron for nails and horseshoes and chains and such things. Slowly and patiently workers made a little steel for very special articles. Even one hundred years ago steel was too costly to use for such big things as engines, rails, and machines. Yet, men needed good, cheap steel if they were going to continue to improve their ways of living.

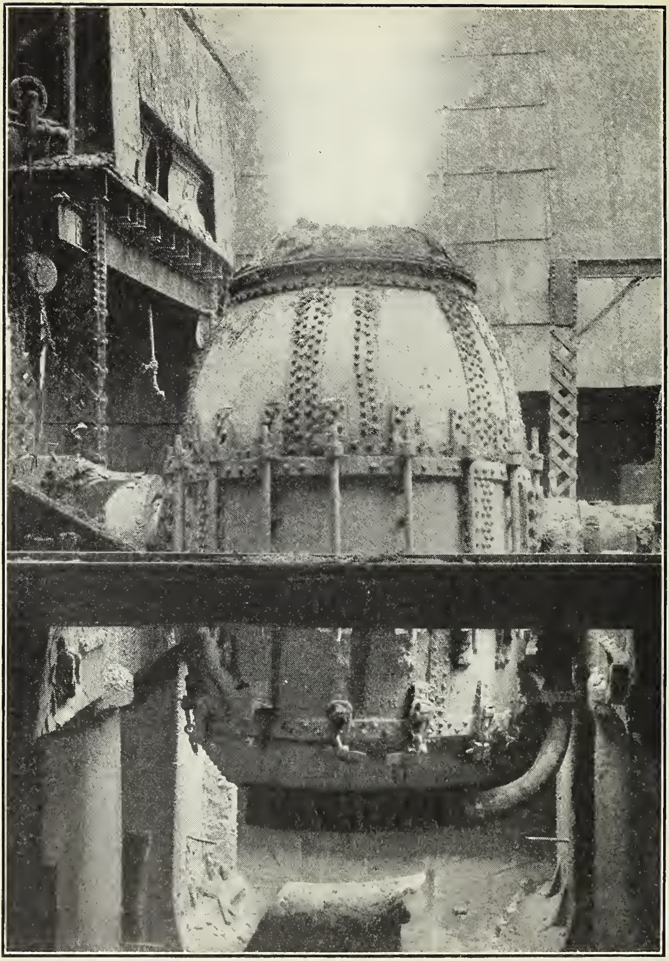
Ironworkers puzzled long and hard about ways of making steel quickly and cheaply. They knew how to make drafts of air to help the fires in their furnaces, but for hundreds of years they had been careful to see that no cold air struck the iron as it was being melted. Then one day, in 1846, in Kentucky, William Kelly saw something queer happening in his furnace. Accidentally a cold draft of air touched the hot iron in his furnace in a spot where there was no charcoal, and from this spot there flashed a hot white flame,



The Kelly Converter

much hotter than the rest of the mass in the furnace. On that day William Kelly discovered that more air in the furnace made a hotter fire and burned out more impurities from the iron than could a coke or charcoal fire alone. He had found a quick way of making steel, the metal most needed in all the world. People laughed at Kelly, and he received very little reward for having made one of the greatest discoveries of all time.

A few years after Kelly's amazing discovery, Henry Bessemer (bĕs′ĕ-mẽr), in Sheffield, England, set to work to see if he could make steel cheaply. Bessemer probably did not know of Kelly's discovery, but he decided to try shooting great drafts of air through melted iron to burn out the impurities and make it stronger. In a large pot he put very hot iron and through it forced a powerful blast of air. The result was not steel but a very good kind of iron. When Bessemer tried to make this good iron in great amounts he failed and for two years he worked without success. Then he had the idea of building a large pot or converter with many holes in the bottom through which to blow the air. When his converter was ready he started a great blast and ordered his workers to pour half a ton of melted iron into the huge pot. Soon there was a tremendous roar and sparks flew everywhere. When the exploding stopped, however, Bessemer found that he had made good steel. In a few minutes he had made as much good steel as it usually took a month or more to make.

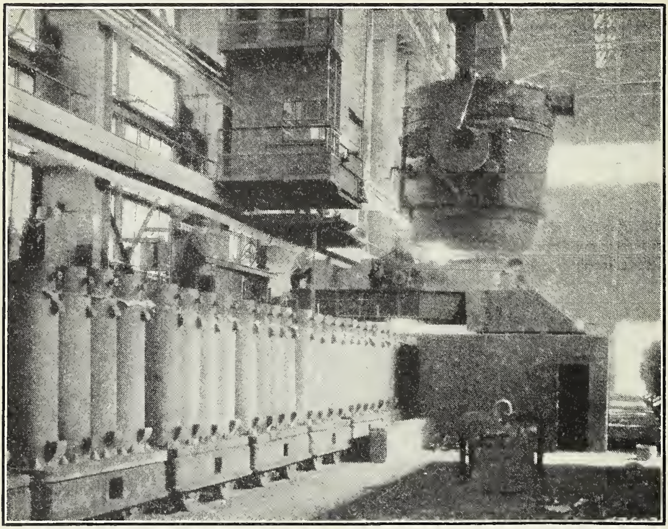


Courtesy Carnegie Steel Co.

A BESSEMER CONVERTER, in operation. Notice the flames blowing out at the top.

Bessemer's troubles were not over yet. When other ironworkers paid for the right to make steel in Bessemer's way, they failed. Then people laughed at Bessemer in England just as people in Kentucky had laughed at Kelly for his notions. Bessemer went to work to find out what was the matter with the steel that others were trying to make. He soon found that there was something called phosphorus in the iron ore which most of the English ironmakers were using and that it was the phosphorus which was ruining the steel. Bessemer then sent to Sweden for iron ore that did not have phosphorus, and again his way of making steel was successful. Later on iron and steel workers found out how to get rid of the phosphorus in iron ore. At last men could make steel quickly and cheaply enough to use it for machines, engines, iron rails, bridges, and for hundreds of other things.

Of course improvements in the ways of making iron and steel quickly and cheaply did not stop with Bessemer. Most of the little iron furnaces of Europe and America disappeared and in their places came great iron and steel mills. In our large mills we still use the Bessemer way of making steel, but workers have found that steel made in the "open hearth" way is of more even quality. Electric furnaces now make the steel used for very special things, such as nickel steel for the armor plate on battleships, vanadium steel for automobiles, and chrome steel and tungsten steel for the strong, sharp cutting parts of machine tools.



Courtesy Ford Motor Co.

In a Modern Steel Mill. The molds, on small cars, are being filled with newly made steel, poured into them from the big ladle. The steel in each mold, when it has cooled and turned solid, is called an *ingot.*

We could hardly imagine what our ways of living would be like today without millions of tons of cheap iron and cheap steel. In our great iron and steel mills today hundreds of miles of iron pipe are made to carry water to our houses and schools and office buildings. Powerful machines quickly make strong shining rails of the hot steel as it comes from the converters and furnaces. Other machines make automobile bodies, countless "parts" for automobiles, fine stainless steel tools, skeletons for high skyscrapers, girders and beams for bridges, vast machines, and hundreds of other things. Because steel is so important in the making of machines, some people say that we live in an "Age of Steel." Think how surprised the patient slow-working ironworkers of earlier times would be if they could see how steel has become one of the most important and plentiful things we use in our ways of living today.

Questions to Answer

1. Why is steel so important to our ways of living?
2. What did Kelly and Bessemer find was needed to turn the melted iron into steel?
3. What kind of furnaces are now used for making steel?
4. Do you think that as many people work at making steel today as worked at it in the Middle Ages?

A Summary

Write a summary of Bessemer's experiment.

Make a List

Make a list of the things you commonly use which are made of steel.

10

Machines

Hargreaves invented a machine to spin thread,
Cartwright invented a machine to weave cloth,
Whitney invented a machine to clean cotton,
Howe invented a machine with which to sew,
Saunders invented a machine to make buttons,
Kelly and Bessemer learned how to make steel quickly,
And now our clothes are mostly made by steel machines.

The stories about these inventions tell us of the coming of the "age of machines." The stories may show us, too, what has been happening since about 1750 in the making of many other products. For example, the coming of machines and factories has:

(1) changed the way of making furniture. In olden times furniture was made by hand, but now it is usually made by machines.

(2) changed the way of making clocks. There are now great factories which make thousands of accurate clocks each day.

(3) changed the way of making nails and pins. In

Eli Whitney's time nails and pins were made by hand, but now they are made by machine.

(4) changed the ways of making tools and machines themselves. Today factories make steel tools and machines—from the smallest screw drivers to the mightiest locomotives.

In the stories that follow you may read about some other changes in ways of making things which took place. In all the stories it is wise to remember that:

Before the invention of machines, most goods were made	*After* the invention of machines, goods were made
By hand,	With machines,
At home.	In factories.

Things to Think About

1. How did many workers feel about the invention of machinery to take the place of hand tools?
2. Do the stories you have just read offer any proof that "one invention leads to another"?
3. Can you think of any good reasons why the cotton gin was invented in America, but the spinning jenny and the power loom were invented in England?

11

Making Shoes

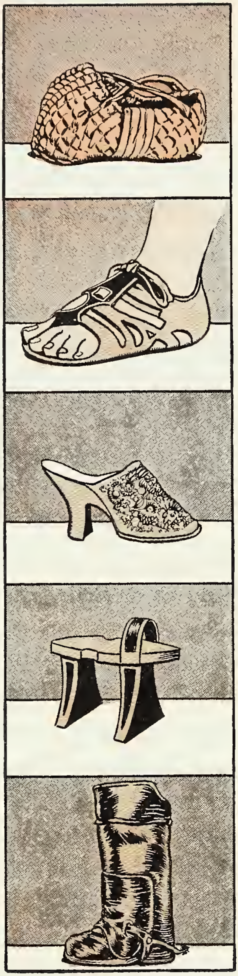
One of the interesting places to visit in Boston is the Shoe Museum. There you may see a valuable collection of shoes worn by men and women of all times and places.

In one part of the museum the cases contain only footwear that was made by hand. There are sandals worn by an Egyptian who lived along the Nile River in ancient times, the dainty sandals of a Greek lady, and the heavy sandals of a Roman soldier. In one case there is an immense boot which protected a knight's leg from the lance thrusts of his enemy. In other cases there are moccasins of the American Indians, and shoes worn by the early settlers in America. There are velvet shoes of China, straw shoes of India, and wooden shoes of Holland. In fact, there are handmade shoes from every part of the world.

It is easy enough to be sure that the shoes worn by the ancient Egyptians, Greeks, and Romans were made by hand. It is easy to believe that the American Indians made their moccasins by hand, and of course we know that the early settlers in America made their shoes by hand in their own kitchens. But we are surprised when the guide in the Shoe Museum tells us that George Washington's shoes were made by hand, and the shoes that Abraham Lincoln wore when he was elected President of the United States in 1860 were made by hand. Then we realize, as never before, for how many, many years all shoes were made by hand!

The workers who made shoes by hand had very few tools to help them. In one case at the Shoe Museum you may see the tools which the early shoemakers used. The sandal maker of early Egypt had only three tools, and during the many centuries that followed, very few tools were added to the shoemaker's kit. The shoemaker who made Abraham Lincoln's shoes had only seven tools.

With only a few simple tools to work with, it took a shoemaker a long time to make a pair of shoes. Because it took



The pictures here show an Egyptian sandal, of grass; a Roman sandal; a medieval slipper in Venice; an English or colonial clog, worn on muddy roads; and a jousting boot.

so long to make them, handmade shoes were very expensive. Because they cost so much, people could afford to have very few pairs of shoes. Still worse, the handmade shoes often did not fit well. Have you ever tried to make two objects just alike? If you have, you know how hard it would be to make two pairs of shoes just alike, or even to make the mates of one pair match. When men had to wear shoes made by hand, they often found that if one shoe fitted well the mate did not, or if one pair was satisfactory, they could not get another pair just like it.

But such troubles are over today, because most shoes are made by machines in factories. The guide in the Shoe Museum will show you a long row of pictures of the machines found in shoe factories today.

There are machines that cut the uppers of shoes, others that cut the soles, others to sew the parts of the uppers together, and still others that sew the soles to the uppers. There are machines that shape the heel, stamp it into the rest of the shoe, and then smooth and polish it. Some machines put fancy edges on shoes, and some cut pretty designs in the toes of shoes. The eyeletting machine punches holes on both sides of the shoe and puts in the metal eyelets. Another machine laces the shoe and ties the shoestring, all in the twinkling of an eye!

If you could watch men and women run the machines in a shoe factory you would see how quickly today pieces of leather are made into well-shaped

Photo by Lionel Green

One of the Many Different Machines in a Shoe Factory

shoes. Then you would wonder how and when the change came about, from the shoemaker who made the whole shoe by hand with simple tools, to the modern shoe factory filled with machines worked quickly and easily by skilled workmen.

The guide in the Shoe Museum can answer your question. He will tell you that the first shoe factory was started in Lynn, Massachusetts, in 1750 by John Adam Dagys. In those days all shoes were made by hand, and the best shoemaker could make only five or six pairs of very plain shoes in one week. To make boots or fancy shoes took much longer. Dagys had an idea that if a man should do nothing but make soles all day long he could go much faster than if he had to make the entire shoe. He would not have to change his tools so often or make so many different motions as when making the whole shoe.

Dagys gathered a number of shoemakers together in one shop or factory to try out his idea. Each man made only one part of the shoe and learned to do his one task very well. Before long, even working by hand, the men in Dagys's factory were turning out many more pairs of finished shoes in one week than they could if each one had to make all of the parts of the shoe. Other men followed Dagys's idea, and by 1795, in Lynn alone, men were making in factories 300,000 pairs of shoes in a year.

When Howe invented the sewing machine, shoemakers became interested in it. So far, all the sewing on shoes had been done by hand. Shoemakers decided that a sewing machine might help them in their work. In 1858 Lyman R. Blake, a shoemaker in Abington, Massachusetts, invented a machine by which the soles of the shoes could be sewed to the uppers. That machine saved a great deal of time and effort. Since that time hundreds of other machines have been invented. Today, there is no step in making shoes that is not done by machinery better than it could be done by hand.

In the beginning machines were so expensive that one man could not own every kind of machine to be used. For that reason small factories were started where only one part of the shoe was made. For instance, a man who could afford to own a machine to cut soles spent all of his time turning out soles for other shoemakers to buy. If a man owned a machine that sewed the soles to the uppers, other shoemakers brought their shoes to him for that process. When it grew easier to have all the machines needed in making the shoe, factories to make the whole shoe were started. But some of the factories that were making one part of the shoe continue to do so even today.

America is not the only country in which shoes are made in factories by machines. A man from Czechoslovakia (chĕk-ō-slō-vä′kĭ-*ȧ*) learned all the processes of shoemaking in America and then went back to his own country and started a very large shoe factory. Now, he turns out thousands of pairs of shoes for the people of central Europe. Germany, England, Russia, and other countries have large shoe factories where shoes are made by machines.

In spite of the many shoe factories, we can still find shops where shoemakers make very good handmade shoes for people who want them. Some shoes are made by hand to fit crippled or deformed feet. And there are still a few places in the world where people continue to make all of their footwear by hand. Handmade shoes are still very expensive. Every year more people all over the world wear shoes made by machines in factories.

Millions of machine-made shoes are made in the factories of America every year. Since so many shoes are made, you may have several different pairs of shoes at one time. You may have dress shoes for Sunday, sturdy shoes for every day, tennis shoes for the playground, and boots for stormy weather. You know, too, that both of the shoes in a pair will match and that you can get many more like them, for machines always do their work exactly as they have done it before.

A Time Line

Make a time line showing changes in ways of making shoes.

Drawing Time

Draw pictures of the different shoes described in the story, to show how shoes have changed since early times.

A Class Visit

Visit a shoe factory and write a report on what you see there.

12

Then and Now

Before the age of machines, a shoemaker, with the help of a few simple tools, usually did all the work of making a shoe by hand at home.

In a shoe factory today, the entire shoe is made, not by one worker, but by many men and women who have learned how to operate different kinds of machines.

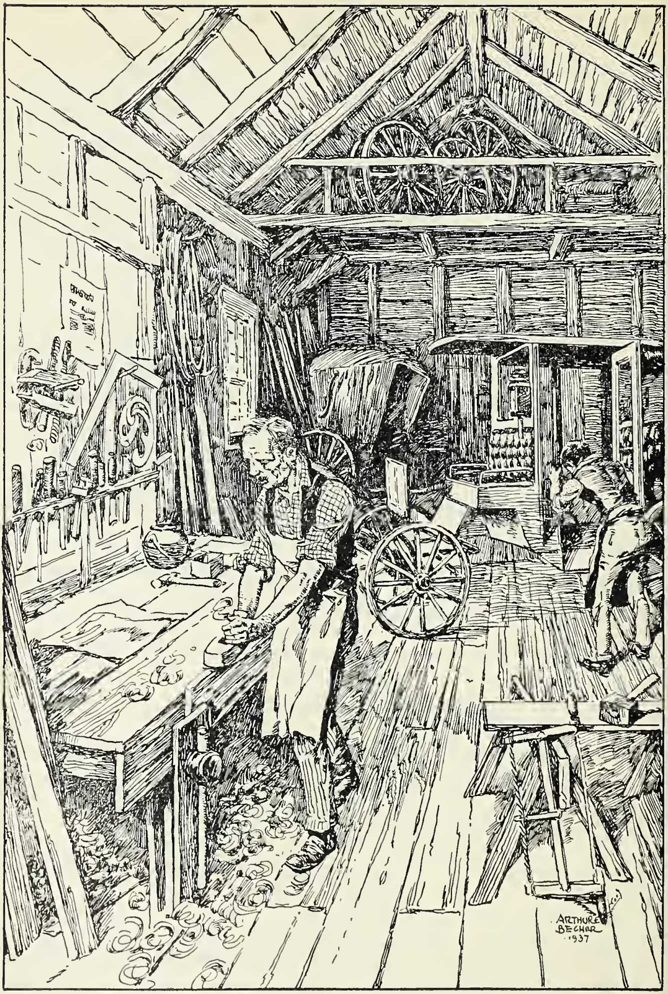
What is true about shoes is true about cloth and most of the other things which used to be made at home. Today, most of the articles we use are made in factories by machines which are operated by men and women, each of whom has learned how best to run some special machine that does only part of the work.

For Your Class Museum

Arrange pictures and models to show how goods are now made in factories with machines rather than in homes with hand tools.

Words

Make a list of all the new words used in the stories of this unit. What words help you to understand that we live in an "age of machines"?



A CARRIAGE FACTORY of the early days, where carriages were made with hand tools.

13

Making Automobiles

In Parsonsfield, Maine, there is a building that from the outside looks like a sturdy New England barn. But if you were to go inside it you would learn that it is not just an ordinary barn. In fact, not many years ago, it was a carriage shop. The man who owns the shop would tell you how he used to make fine carriages. He would tell you how he made the wheels, the sides, the tops, the seats, and how he put all the pieces together into whatever kind of carriage he was asked to make. If you had time to listen, the owner could tell you about many a fine carriage that rolled out of his shop all ready to be driven away.

The carriage shop in Parsonsfield is closed now, as are many carriage shops all over the country. Automobiles have taken the place of carriages. In the beginning, automobiles were too expensive for many people to buy, and carriages were still made. But when automobiles became cheaper, people no longer bought carriages, and the carriage shops had to close. Today, millions of automobiles are made.

One reason why automobiles are cheap is because the automobile industry is highly specialized. By "highly specialized" we mean that automobiles are made in factories where each worker does one special task all the time. By doing just one task, he can learn to do that task so quickly that he can do a great deal of work in a very short time. He can do much more work than if he had to change his position or his tools very often. With many workers, each working rapidly at his own special task, a complete automobile can be made in a very short time. Specialization saves time. Saving time helps to make automobiles cheap.

The automobile industry is so highly specialized that not all of the parts of an automobile are made in any one factory. Special factories make special parts. For example, there are factories that make nothing but batteries for automobiles. We say that such factories specialize in batteries. Other factories make nothing but car bodies, so we say they specialize in automobile bodies. Factories that specialize in rubber goods make automobile tires. Other factories specialize in making automobile engines, springs, or radiators. Still other factories specialize in putting the car together, or "assembling" the car.

Occasionally, we find factories that make many of the parts of the automobile and assemble the whole machine. These factories are very large and are made up of many different buildings and rooms. If you can take a trip through such a factory you will get a good idea of what specialization is.

Before you enter the factory, you will see huge trucks roll through the gates carrying the various parts of the automobile which this particular factory does not make. The trucks may contain tires, batteries, springs, or radiators which have come by boat, train, or truck from the special factories which made them. Inside the factory, although it is noisy and busy and seems confused, everything is done in a very orderly way.

In one room you see the great furnaces that melt the short, thick iron bars called "pigs" into white-hot iron that runs like water. You see the liquid iron poured into "molds." When the iron is cold, you see that the molds have shaped it into parts of the automobile engine. In another room you see the parts of the engine put together.

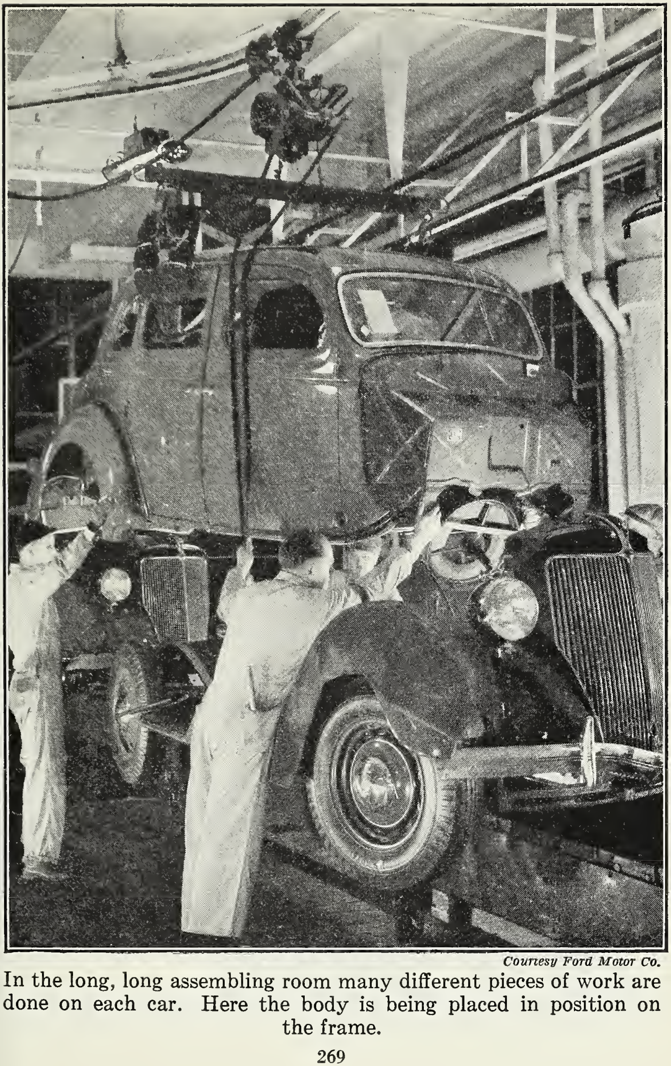
In another large room you see long steel bars cut and fastened together for the frame of the car. In the next room you see sheets of steel rolled, stamped, and cut into the right shapes for the sides of the body, the doors, hoods, and fenders. One building is full of lathes. These are special machines for making axles and crankshafts. You visit the paint shop where the paint, enamel, and varnish are put on the different parts of the car before any of them are assembled.

On and on you go through the large automobile factory. You see where the seats are made, the wheels, gears, brakes, and fans. And wherever you go, you see many workmen, many different kinds of machines, and many different tools. You see that each worker has one special job to do and one special tool or machine with which to do it.

But you have not yet seen the whole car put together. To see that you must go to the assembling room. The assembling room is very long. In the floor there are several pairs of moving tracks on which cars are being assembled. The tracks are raised so that the workers do not have to bend over too far to work on the machines. The men stand alone or in pairs on either side of the moving track, from ten to twenty feet apart. Beside some of the men there are piles of tires or wheels or whatever part they are to add to the car. Along the ceiling there are other moving tracks from which hang other parts of the car, such as hoods, fenders, seats, and steering wheels.

It is very interesting and even exciting to see the men put the automobiles together. At one end of the moving track the empty frame is placed. As the track moves it brings the frame in front of one man after another. Each man must do his task quickly and well. If the part he is to add to the car is on the floor beside him, or on the moving track above, he must reach for it in time to put it on the frame as it passes by. As soon as one frame goes by, another arrives. Hour after hour the men work, each at his one task, changing a naked frame into a finished automobile.

It is very interesting to see the wheels put on the frame; to see the engines, the radiators, the fenders, and the other parts assembled. It is exciting to see the body of the car swung down from a hole in the ceiling just in time to be fastened on the passing



Courtesy Ford Motor Co.

In the long, long assembling room many different pieces of work are done on each car. Here the body is being placed in position on the frame.

frame. Before you know it, an automobile is finished and a man drives it out into the yard to test it.

When you see how quickly automobiles are made you understand better why the old carriage shop in Parsonsfield is closed. You understand, too, what is meant when one says that the automobile industry is highly specialized. If you could visit factories where other things are made, you would see that the work done in all factories is specialized. Factory work means specialization.

For Your Notebook

Write a paragraph for your notebook telling what this sentence means: "The automobile industry is highly specialized."

Make a Summary for the Class

Make a class summary of the story of how the automobile is made. Visit an automobile factory or repair shop and list the various parts that go to make up this machine.

For the Bulletin Board

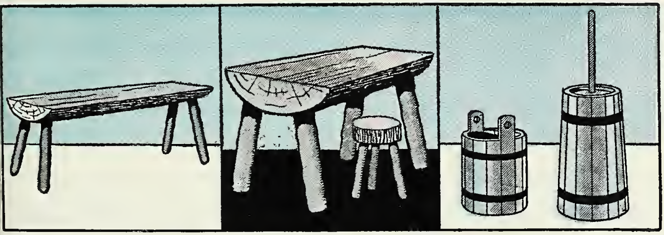
Perhaps you can find pictures of automobiles in their different stages of being assembled.

14

Machines and You

If you were living in colonial days, you would have to do for yourselves a great many things that machines now do for you. You or your parents would have to make by hand the things you wear and use, and many of the things you eat. Your clothes would be of homespun cloth, dyed with the juice of berries from the woods, and fastened with hand-carved buttons. Today machines make your clothes and your shoes and your pieces of furniture—and you have many of them all.

Nearly everything in the colonial home was made by hand. Instead of having comfortable cushioned chairs to sit on, most colonial children had to sit on stiff chairs or benches made from trees their fathers had chopped down. The chairs would be held together by wooden pegs or hand-made nails. Today



CRUDE FURNITURE, BUCKET, AND CHURN MADE WITH HAND TOOLS you see shining factory-built stoves and furnaces instead of sooty hand-built fireplaces for burning wood. You may have electric toasters now. Electric lights have taken the place of flickering candles.

Machinery helps us to get our food more easily. Machines harvest the grain, grind it into flour, bake it into bread, and even slice it ready for the table. All that was once done by hand. Vegetables and cereals, fruits and jellies, may come to your pantry all cooked and packed by machinery in cans or boxes, ready to use. Butter, too, comes churned and molded by machinery. In olden times your muscles would have ached from the long hours spent thumping the heavy dasher up and down in the churn until the cream had turned to butter. Milk, bottled by machinery, is delivered at the door.

Because of machinery, going to school is easier now. There are few schoolrooms made of logs, where the cold wind whistles through cracks between the logs. You have warm buildings made of machine-made bricks and machine-shaped wood. You have plenty of paper and pencils instead of slates to write on. You have books, too, printed by the thousands on fast power presses. And the school busses that may take you back and forth are easier to ride in than was the slow wagon of earlier days.

Thousands of people work in factories everywhere today helping to make the many things you use. And an interesting fact is that none of these workers

Ewing Galloway

WORKMEN on their way to work in an automobile factory. Compare this with the way men "went to work" in colonial times.

makes the whole of anything, as people used to do. Each worker makes a separate part and then the parts are fitted together to make a whole. This is called *specialization.* This method is quicker and cheaper than the old hand way, but often the work is less interesting for the worker. The machines themselves are made by other machines, and if a part is broken, it is easy to replace it with a new part that will fit. Whole factories spend all their time just making parts of machines.

Because of the many, many things machines have given you, your ways of living today are much pleasanter and richer than ways of living ever were before.

Writing Time

Write a story telling how machines have made life easier and pleasanter for you. Do you know Tippett's poem, "I Like Machinery"?

Write a poem about making things in colonial times.

Drawing Time

Draw pictures showing how our living has been changed by machines. Choose titles for your pictures. Let the class choose the best pictures for an exhibition of things you have made while studying the unit on "Making Goods with Machines."

Reading Time

As you look around on the library shelves and in encyclopedias, you can find stories about the inventions that have helped to make goods plentiful and cheap for us. See if you can find some of these books.

Inventions That Have Given Us Machines:

Bachman, Frank P., *Great Inventors and Their Inventions.*
Forman, S. E., *Stories of Useful Inventions.*
Perry, Frances M., *Four American Inventors.*
Stone, G. L., and Fickett, M. G., *Famous Days in the Century of Invention.*

Books That Tell How Many Things Are Made:

Bassett, Sara W., *The Story of Lumber; The Story of Wool; The Story of Leather; The Story of Glass.*
Carpenter, Frank G., and Carpenter, Frances, *The Clothes We Wear; The Houses We Live In.*
Carpenter, Frances, *The Ways We Travel.*
Curtis, Alice T., *The Story of Cotton.*
Gibson, C. R., *The Romance of Modern Manufacture.*
Lent, Henry B., *Diggers and Builders.*
Petersham, Maud and Petersham, Miska, *The Story Book of Iron and Steel; The Story Book of Clothes.*
Pryor, William C., and Pryor, Helen S., *The Glass Book; The Paper Book; The Steel Book.*
Reck, Franklin M., *Automobiles from Start to Finish.*
Scarborough, Dorothy, *The Story of Cotton.*
Tappan, Eva March, *Diggers in the Earth; Makers of Many Things.*
Unit Study Books, No. 306: *The Story of Paper.*
Unit Study Books, No. 602: *Inventions, How They Help Us.*
Watson, Elisabeth, *The Story of Textiles.*
Wilhelm, Donald G., *The Story of Iron and Steel.*
Williams, Archibald, *How It Is Made.*

Talking Time

In this unit there is not space to tell of the many, many inventions, machines, and factories that help to give us things quickly and cheaply compared with earlier times. As you read in the library books and encyclopedias, you will find so many stories about the way the things we use are made that your class will have to do some careful choosing if the most important and interesting stories are going to be told during "Talking Time." Here are some suggestions:

In Forman's *Stories of Useful Inventions,* you can find the story of the loom from the days of the simple stick to the days of Jacquard, who invented a way of weaving beautiful figures in cloth cheaply. On pages 87–104 of *Great Inventors and Their Inventions,* Bachman tells the story of the invention of spinning machines—the jenny, the water frame, and the mule. On pages 105–120 of the same book he tells of Eli Whitney's invention of the cotton gin, and on pages 121–141 he tells about the sewing machine. On pages 161–185 Bachman tells the story of Henry Bessemer and his invention of a cheap way of making steel. On pages 95–124 of *Four American Inventors,* Frances M. Perry tells about Whitney's cotton gin.

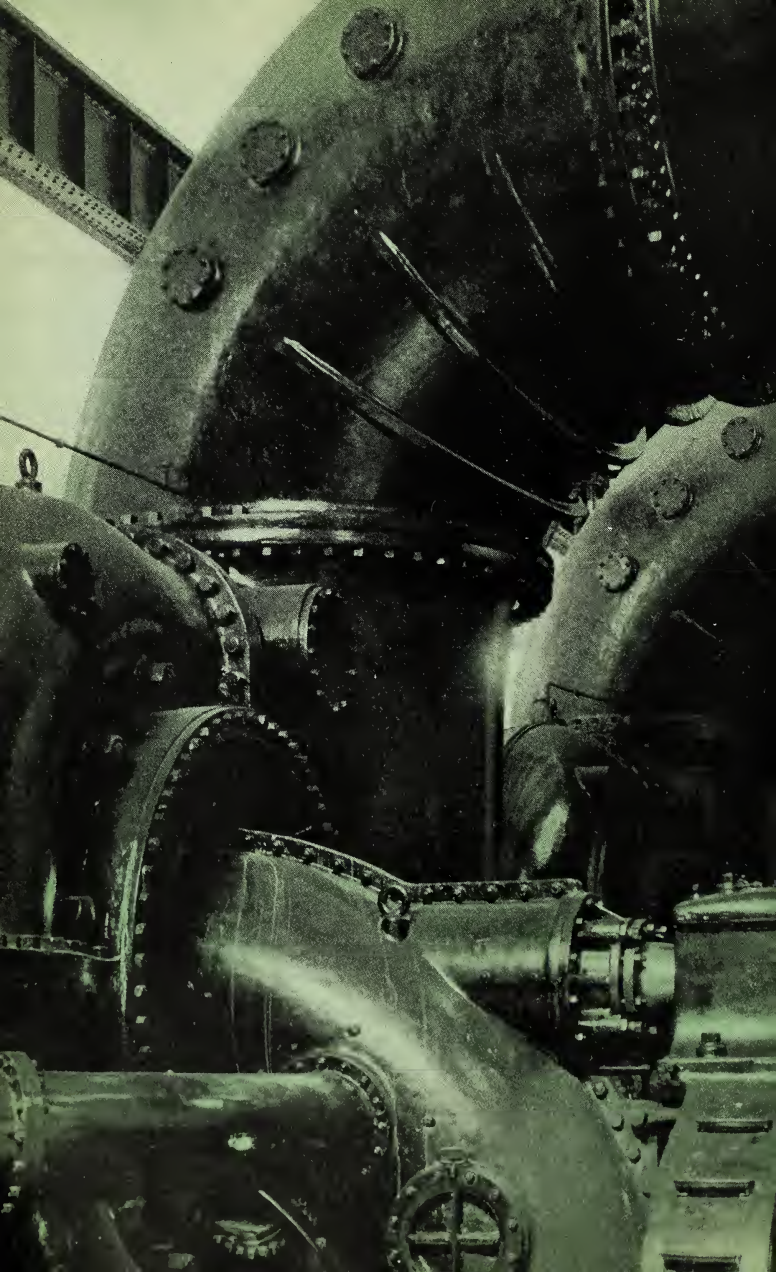
In Carpenter's *The Clothes We Wear,* you can find stories that tell how many of the things we wear are made.

In Carpenter's *The Houses We Live In,* there are stories to tell about such things as lumber, stone and concrete, bricks, iron and steel, nails, glass, wall paper, paints, and many other things that machines make for our homes.

On pages 148–162 of Carpenter's *The Ways We Travel,* you can find the story of how automobiles are made. Bring library books to the class to show the pictures of scenes in large automobile factories.

UNIT IV

THE HARNESSING OF POWER



1

When Muscles Ached

Many thousands of years ago, on the shores of a lake in Switzerland, a primitive man and a boy were cutting down a tree. It was a hard job, for their axes were only sharpened stones, tied to stick handles. Over and over again they struck at the trunk with their crude tools, although their arms and their backs were aching.

After working a long time, the choppers straightened their tired backs. The tree at last had fallen, and the man and the boy chopped off its top and branches. Then the boy ran down the slope to the edge of the lake. He came back with two more men, who tied long strips of leather to the tree and passed the straps around their shoulders and foreheads. With these rough harnesses they began to pull. The first man and the boy took hold of straps and pulled too. At first the log did not move. It was too heavy. The men pulled harder, and at last the heavy log began to move. Slowly, slowly, they dragged it over rocks and underbrush down to the water's edge.

If you had been standing on the shore of the Swiss lake that day so many thousands of years ago, you

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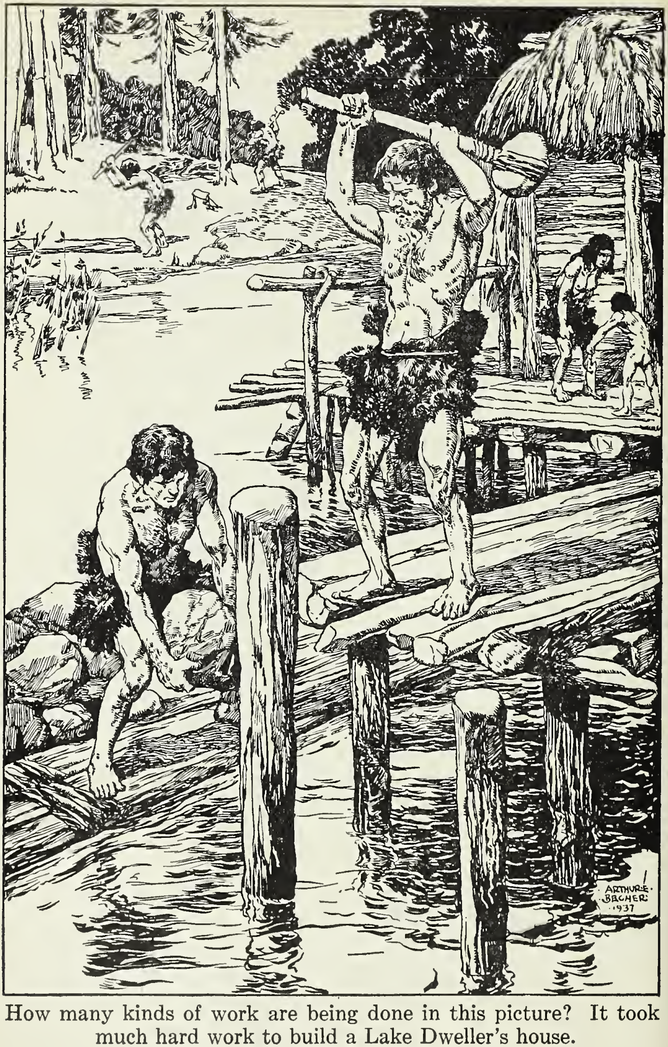
Credit: *Buffalo, Niagara, and Eastern Power Corporation*

On the opposite page you see a small part of a power plant using the tremendous power of falling water at Niagara Falls.



How many kinds of work are being done in this picture? It took much hard work to build a Lake Dweller's house.

would have seen some very interesting sights. The man and boy who had worked so hard cutting and dragging the heavy log were members of a tribe of people called the Lake Dwellers. Out in the lake the tribe had set up many large wooden posts, partly driven into the lake bottom. Stones piled around the foot of the posts helped to keep them standing straight. On the posts platforms were built, and on the platforms there were huts made of woven branches plastered with mud. The roofs of the huts were of bark, or straw, or reeds, and the floors were of rough boards and clay. Living on platforms over the lake was safer than living on the shore. The log which the men had dragged to the water's edge was to be one of the many posts that held up their homes.

One interesting thing about the homes of the Lake Dwellers was that every bit of the work of building them was done by man. There were no machines to help them, and not even horses who could pull. Men's muscles supplied the power that cut the trees and dragged the heavy logs down to the shore. Men sharpened the ends of the logs so that they could be driven more easily into the bottom of the lake. It was muscle power that drove them down. And it was muscle power that lifted heavy stones and carried them to the lake to pile around the posts and make them firm.

When we learn that in one lake there were as many as fifty villages and that the platform for one of them was 1200 feet long and 150 feet wide, we can imagine how much muscle power the Lake Dwellers used. To-day countless machines driven by steam or electricity or water power help us to cut, drag, pound, and do other work. But in the days of the Lake Dwellers, only men's muscles could get things done. How many aching muscles there must have been when man power was the only power man knew how to use!

Bulletin Board

Bring to class pictures of men and women carrying burdens and lifting or dragging heavy loads, for your Bulletin Board. Try to find pictures of loads carried on people's heads and backs.

Acting Time

Imagine that you are living in primitive times when all work had to be done by muscles. Act out some work and see if the class can guess what you are doing.

Muscle Power Today

Make a list of kinds of work done by muscle power today. Here are a few suggestions: moving furniture, loading boats, cleaning streets, building houses.

2

Animal Power for Man

In a hot green jungle in India, some people were building a hut for themselves. They wanted to build their house on a platform above the ground in order to be safe from wild animals. They cut some trees in the forest to use as posts, but they did not have to pull the logs over the ground as the Lake Dwellers did. The people of India had helpers—the elephants. Elephants had been trained to lift heavy things with their strong trunks and tusks, and to carry or pull heavy loads. Elephant muscles had been put to work for man.

Elephants were not the first animals made to work for man. Perhaps the first were cows and oxen, whose strong backs were used to carry burdens many, many hundreds of years ago. One of early man's great steps toward civilization was the taming, or *domestication,* of animals. The domestication of animals helped to make our ways of living.

The idea of using the muscles of animals has helped men all over the world. In every land men train animals which happen to live there. In the frozen north reindeer pull the sledges of the Lapps, and dog teams pull the sledges of the Eskimos. Across the hot sands of Arabia the camel walks on his long legs and broad feet. This queer-looking beast is called "the ship

of the desert" because he moves so easily over the dry, yielding sand and carries his food supplies along with him. The camel can store in part of his stomach enough water to last him for days, and in the hump on his back there is enough fat to keep up his strength if he goes without food for a long time. It was on the backs of camels that the early traders from the East brought their goods over the trade routes to Europe.

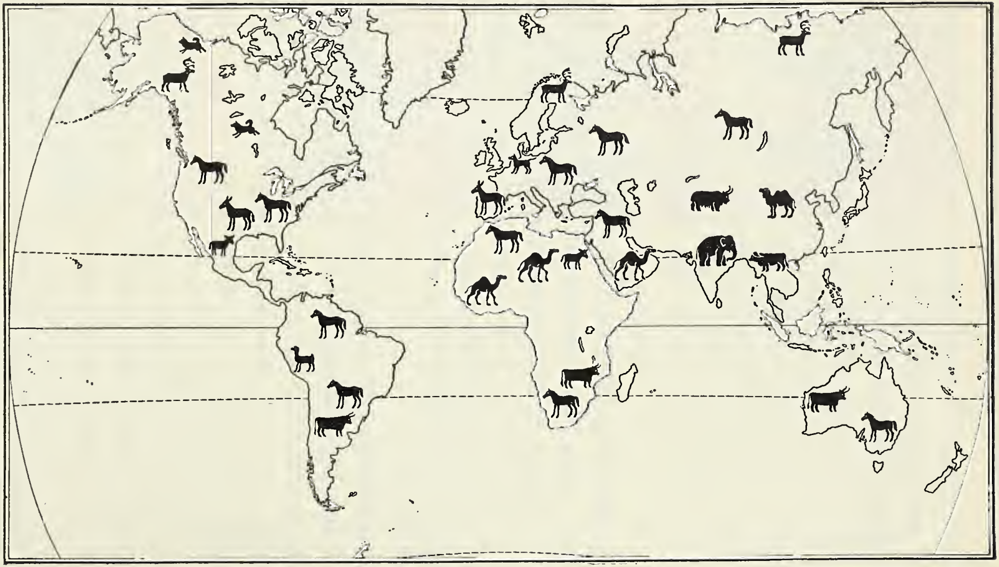
In Holland and in Belgium there are large dogs which draw milk carts to market. In Tibet (tĭ-bĕt′) in central Asia the yak is the chief work animal. In the mountains of South America a shaggy animal called the llama is used. Llamas and goats can travel up and down the steep mountain slopes without slipping. Mules, too, are very safe for mountain travel.

The pictures here show four of the animals often used as burden bearers: dog, llama, mule, and elephant.

It is not alone in mountainous regions that donkeys and mules are useful. When the ancient Egyptians first built boats on the River Nile by filling animal skins with air and building a rough raft on them, donkeys were floated down the river along with the cargoes. The rafts were taken apart at the end of the journey, and the donkeys were right there to carry the empty skins back to the starting place. There another raft could be made for another trip downstream.

You can see from this long list of animals, that man has found a good many muscles to help him with his work. No matter in what kind of country he lives—whether in the sandy desert, on the steep mountain sides, among the hot green jungles, or in the midst of snow and ice, he has found some work animal suited to just that land.

The most important working animal in our own country is, of course, the horse. This gentle animal that you all know so well has pulled and carried many, many millions of tons for the people of America. The horse is still very important today, though fewer horses are now used than there were before the automobile was invented. And we still use the term "horsepower" to measure the work that can be done by engines. Inventors found that the work done by a heavy horse was equal to the work of lifting 550 pounds of weight one foot up from the ground each second. This became the measure of power. When you hear someone speak



Animals That Work for Man

Can you name the eleven different kinds of animals shown on this map, and tell what they do for man? In what continent, or continents, is each animal found?

of a 60-horsepower engine, think of the time when the muscles of animals were all man had to help him do his work.

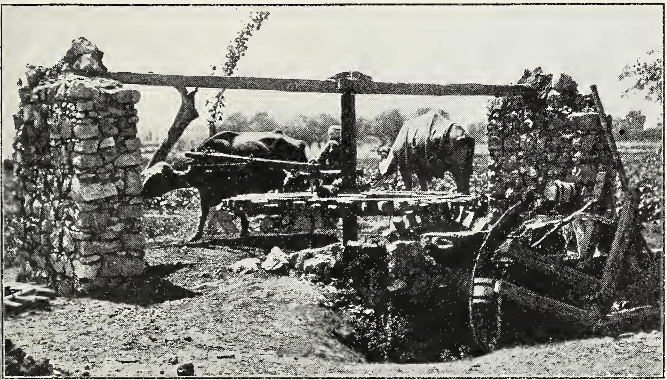
A Beast-of-Burden Zoo

Model animals out of clay in order to make a beast-of-burden menagerie or zoo. Can you think of some work animals not mentioned in this story?

Find pictures of different animals pulling loads instead of carrying them on their backs.

Writing Time

Write one sentence telling why work animals are valuable to man. Write a definition of the word *power*.



Royal Consulate of Egypt

This picture shows one of the work animals not mentioned in the story—a water buffalo. Its work here is to turn a wheel that lifts buckets of water for irrigation.

3

Harnessing the River!

Sokar was very tired as he sat by the Nile River in the cool of an evening long, long ago. All through the long hot day he had been dipping buckets of water from the river. He had poured the precious water into the ditch which irrigated the farm on which he and his father worked in ancient Egypt. It was hard work to lift the heavy buckets of water, and the muscles in his back ached as he sat by the river resting.

Sokar was thinking as he rested. He had noticed that every time he dipped the bucket at the end of his pole into the stream, the strong current swept the bucket along. Sometimes it almost pulled the other end of the pole out of his hand. He thought to himself, "The current of the Nile is more powerful than I am. Can I not make the river do my hard work for me?"

Perhaps it happened that an old wheel lay on the bank beside Sokar. The boy picked it up and started to play with it. He put a long stick through the hub in the center of the wheel, and, as he sat on the river bank, he dipped the wheel in the river and watched the water splash about it. Slowly the wheel began to turn on the stick. The boy watched it with interest.

As Sokar looked at the wheel turning in the water, an idea came to him. If there were buckets hanging along the rim of the wheel, each time the wheel turned in the water it would lift buckets full of water as it turned around. What he needed was a wheel with paddles or blades on it to catch the current better. On the rim of this wheel he could fasten several buckets. If he could set such a wheel between two posts in the water, it would turn around as the current of the river swept against its paddles and would do work for him.

Sokar jumped to his feet. With his father's help he could make such a wheel. It would dip up the water for him, and his arms would not ache so much at the end of the day. He could scarcely wait to get home to tell his father and brother his new idea. They listened to Sokar eagerly. If they could make the river act as their servant they could raise more grain with less work. The next day Sokar and his father set to work to make a water wheel. The other farmers laughed at them and said they were wasting their time. But they kept on, and after many days the wheel was finished.

The whole family gathered at the river to see whether it would work. It did! Sokar shouted for joy, and his father was very happy. Day after day as they used the wheel they thought about it and decided that they could make a better one. They continued to make the wheel work better. They found a way to make the buckets turn upside down as they reached the top. Then the buckets emptied the cool water right into a trough which led to the ditch used for watering their growing crops. No longer did Sokar have to carry water all day. No longer was he so tired when evening came. He had made the river do his hard work for him. Soon there were many water wheels along the Nile.

Sokar had learned a wonderful thing. In the river current there was power to turn the wheel. By using power man is able to do many wonderful things today.

We really do not know who first thought of harnessing the power in flowing water to work for man. It may have been a bright boy or girl in far-off China or India. Perhaps it was a lad in that ancient land along the banks of the Nile—a lad who really acted just like the make-believe Sokar of this story. Whoever it was, we owe him a great debt for taking some of the first steps to make nature's power work for us.

Ancient peoples found that the water wheel could do more than lift water for them. They learned to make it grind their grain as well. The axle of the water wheel was made longer, another wheel was fastened on it, and notches were cut in the edge of that wheel. Two flat, round millstones were used for grinding the grain, and on the top of the upper millstone notches were cut. As the notched wheel at the end of the axle turned, it caught in the notches around the rim of the upper millstone and turned it. It took man a long time to harness water power to the heavy millstone, but at last the water mill turned the stone and the grain was ground. For centuries man has used water power to help him. Water wheels have ground grain, watered crops, and turned the wheels of factories.

When the new machines for spinning and weaving were invented, water power became more important than ever. Water power made these machines work. Factories and mills for making cotton cloth were built on streams that could furnish water power. Cities grew up about these factories and mills because water power was there to work for men.

Factories which use water power have been built in many parts of our country. Among the cities where water power furnishes much of the power used are Minneapolis in Minnesota, Wilmington in Delaware, and Philadelphia, Harrisburg, Reading (rĕd′ĭng), and Bethlehem in Pennsylvania. Waterfalls near the Atlantic coast supply power also for mills and factories in Columbus, Macon, and Augusta, Georgia; in Durham and Raleigh (rô′lĭ), North Carolina, in Columbia, South Carolina; in Camden, New Jersey, and in many other places.

When man learned to make the water do part of his tiresome work for him, his life was easier than it had been before. He had used his head to save his muscles.

Today we still use flowing water or waterfalls to furnish power for us. We seldom use simple water wheels. Giant machines harness most of the water power today. None of the modern machines could be used, however, had not someone long ago first got these three ideas:

1. *Man's muscle power is not enough to satisfy his wants.*

2. There is power in flowing or falling water.

3. When water power is harnessed it does the work of many aching muscles.

A Model Water Wheel

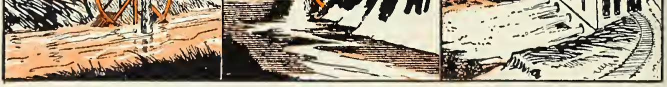
Make a model of a water wheel for your museum. Look up "water wheel" in the encyclopedia. Explain to the class the difference between an "overshot" wheel and an "undershot" wheel.

Drawing Time

Draw a picture to show how the power of a river which has no waterfalls can be harnessed. Why is a dam necessary when there are no waterfalls in a river?

A Poem

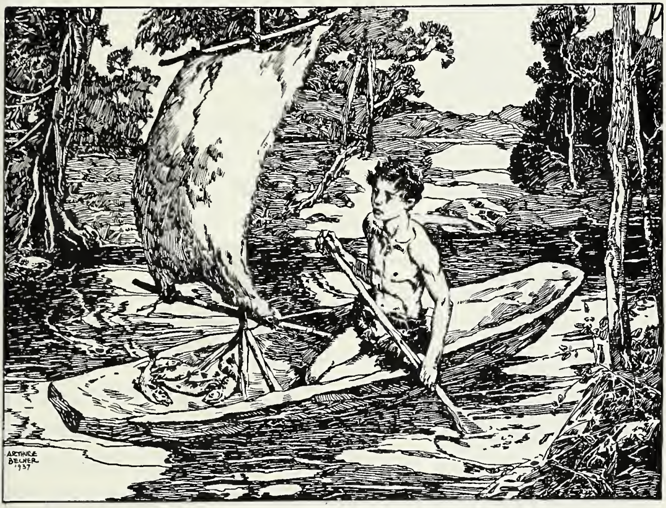
Can you find a poem about a mill wheel? Or perhaps you can write such a poem.



Men have learned better and better ways of harnessing water power. Compare the water wheels in the first two pictures. The third picture shows a power house in which turbines harness the power.

4

The Wind at Work



A primitive man finds that his crude sail works well.

Ga (gä) was happy as the wind blew through his hair. The breeze filled the sail on his dugout, and his little boat rode swiftly down the river. He would soon be back in the village of his tribe with his fine catch of fish. It was easier to travel on the river since he had made a sail for his canoe. It was only a crude sail. Ga had stretched the skin of a wild deer over a rude frame. The sail worked very well, however. It caught the wind, and the power in the breeze pushed him all the way home. Sailing was much easier than paddling.

We do not know who first had the idea of making the wind work for man. Thousands of years ago, in primitive times, man learned to harness the wind with a simple sail. Gradually man learned to make better sails for his boats. He found ways to make the sails catch the wind from any direction it might blow. You have seen pictures, and read stories, about the sailing vessels of ancient, medieval, and modern times. The wind pushed these large boats along rivers, and on the oceans of the world.

It was not only to push boats that man made the wind work. Sometime during the Middle Ages man learned to make the wind as well as the water turn wheels for him. He invented the windmill. First he built a tower or mill. On the top of the mill he put a large wheel with slanting sails or blades on it. When the wind blew against the sails of the wheel, the wheel turned around and around. The wheel was joined, by a rod and another wheel, to a great millstone at the bottom of the mill. The power in the wind was so strong that as it turned the wheel around, it turned the heavy millstone as well. The miller put his grain between that millstone and another stone under it. The wind ground the grain into flour.

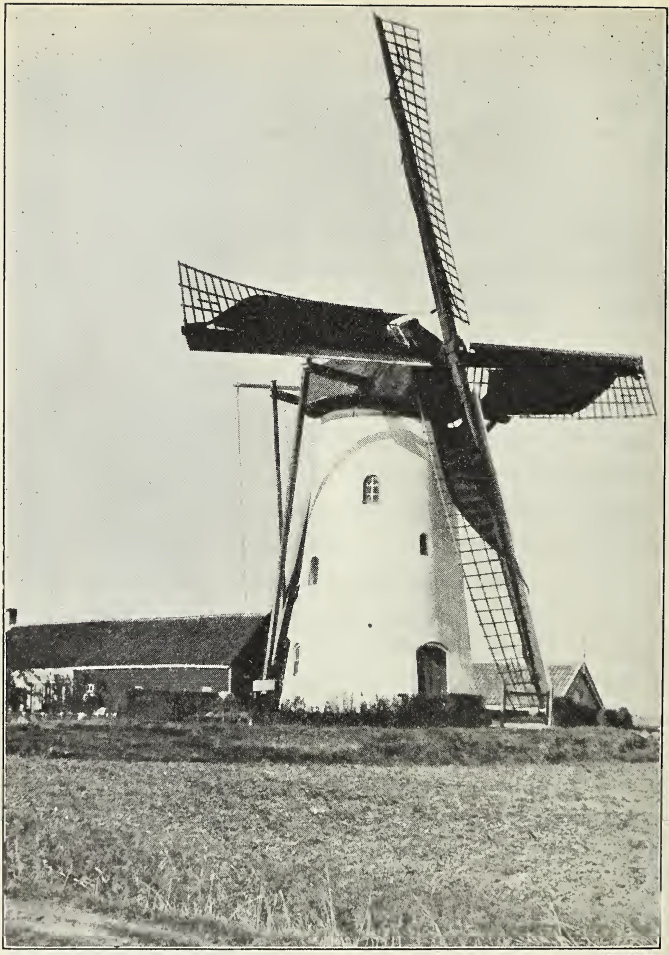
Windmills were a great help to millers who were not near streams, and could not use water power to grind their grain. These early windmills worked very well as long as the wind blew evenly, from the right direction, so that the sails could catch the wind and make it work. But some of the time the wind blew the wrong way, and then the stone would not turn.

Gradually man learned to make better windmills. He built the mill on a little circular track. When the wind blew from the wrong direction men and mules pushed the whole mill around so that the sails could catch the wind.

Later, man learned a better way of supporting the wheel with sails on it. This wind wheel, often called the windmill, had a big vane fastened to it, and would always be turned to face the wind, so that it would work no matter what the direction of the wind was. And this was done without changing the position of the rest of the mill.

Although the windmill is an old invention, it is still used today. In Holland, or the Netherlands, much

Wind power is still used today, to sail boats and turn windmills. Does wind help airplanes? See if you can find out.



Gendreau

A Windmill in Holland. The slanting framework of the "wind paddles" is only partly covered with canvas. The part covered can be made larger or smaller as the wind blows gently or hard.

of which is below the level of the sea, windmills are used to pump the water from the low land. For hundreds of years the Dutch have made the wind work to help them keep such land from being covered by the sea.

No doubt you have seen windmills in your own country. Here they are often used to pump water from wells for cattle and horses to drink. Sometimes a windmill is used on a farm to pump water into a tank in the upper part of the house. Then people can turn a faucet and get water brought to them, by the power of the wind, from far underground.

When man learned to harness the wind, life became easier for him. Wind power pushed boats and turned wheels, and saved many muscles from aching.

For Your Bulletin Board

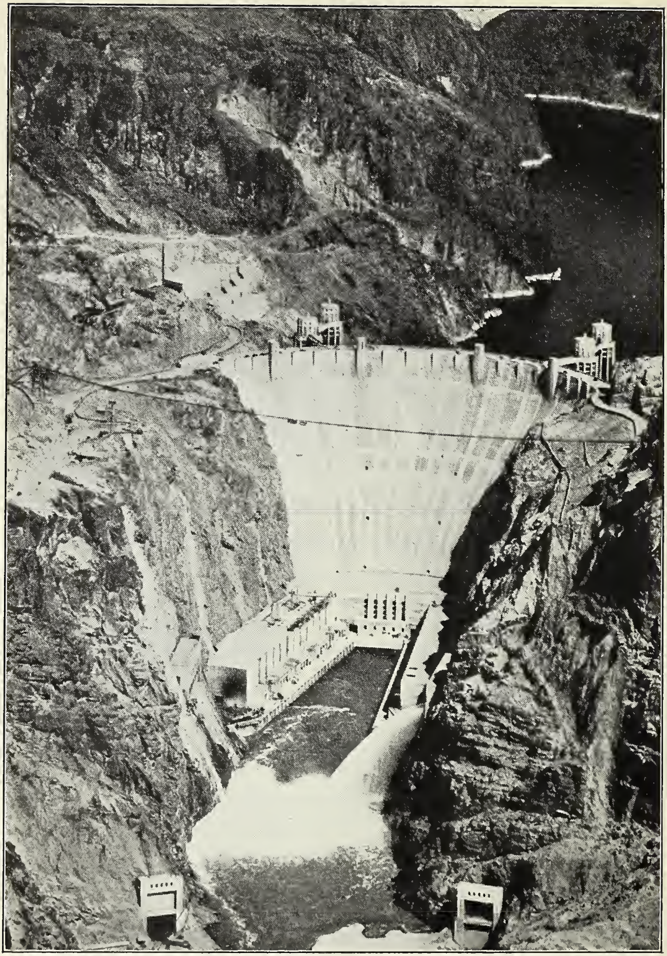
Collect pictures of the wind at work for men.

Sails

What strange use of sails is mentioned in books about China?

Ask someone who knows how to run a sailboat to visit your class and tell how a sailboat works.

Build model sailboats for your class museum.



United Air Lines Photo

AIRPLANE VIEW OF BOULDER DAM. At the foot of the dam you can see the powerhouses where the water power is used to create electric current.

5

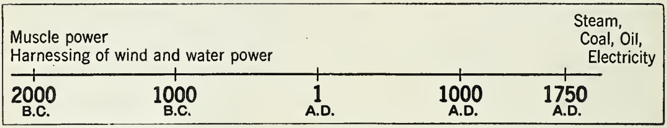
What Power Is

Have you ever thought how much work has to be done in the world so that we may live as we do? Houses have to be built; roads must be constructed; fields must be plowed; books and magazines must be printed. To move anything, whether a small pencil or enough stone to build a great skyscraper, takes power. To lift things or people from the ground floor to the upper floors of a building takes power. To change lumber into furniture, clay into dishes, wheat into bread, and cotton into cloth, takes power. Getting the world's work done depends on power.

Through most of history, as we have seen, men have had to depend on their own muscles, on the muscles of animals, on the currents of rivers, and on the winds that blow, for their power. Men's muscles, however, are not very strong at best. How would you like to turn a millstone to grind grain? How would you like to push a ship? Wind and water are more powerful than muscles. Winds can shake houses and destroy forests; floods of water can destroy cities. When their power is used by man, it can easily turn windmills and water wheels, and push ships across the ocean.

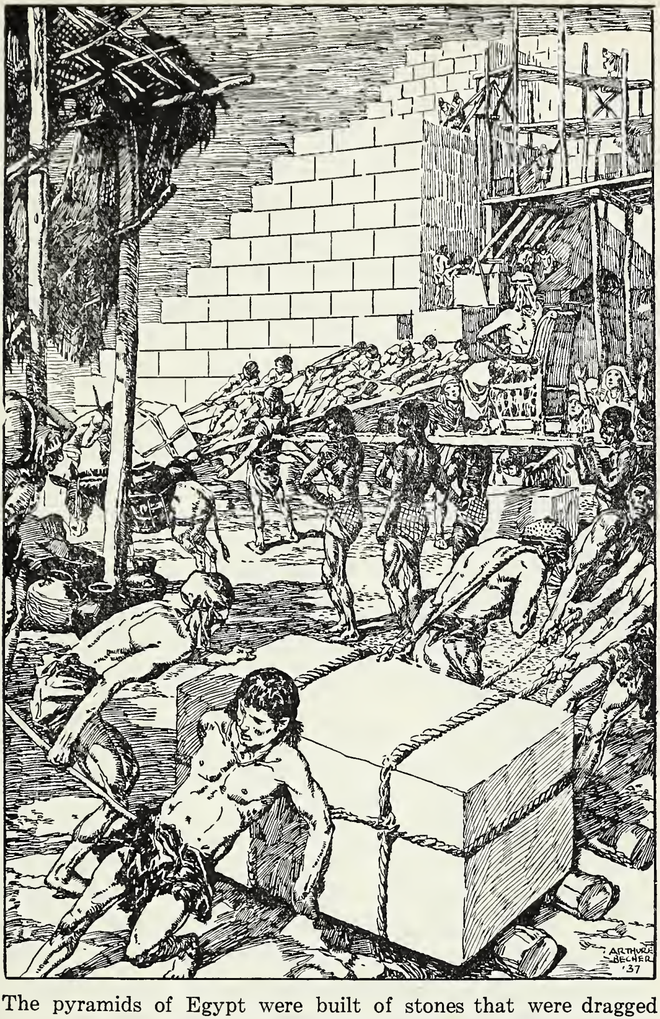
But there are better kinds of power than the winds and waters! Steam can do things that water alone cannot do. Much coal and much oil are used for turning water into steam. Gasoline, made from oil, runs our automobiles. And marvelous electricity silently and swiftly works to make light in the darkness, to run elevators, to run great engines, and to help with the work of the home. Much coal and much water power from falls in rivers are used for making electricity.

Coal and oil have been in the world for thousands and thousands of years, but for most of these years men did not know how to harness them, nor how to use the power of steam or of electricity. The time line below is nearly four inches long. Each inch stands for more than a thousand years.


Muscle power
Harnessing of wind and water power
Steam, Coal, Oil, Electricity
2000 B.C.
1000 B.C.
1 A.D.
1000 A.D.
1750 A.D.

The left end of the time line starts beyond 2000 B.C. The pyramids of Egypt were built before that time. Men dragged the heavy stones across the sands to build them. The water wheel was in use in Egypt about four thousand years ago, in 2000 B.C. Sailboats were used about the same time. Later on, men learned to make windmills. For many hundred years muscles, winds, and water did all the world's work.

The short part after 1750 A.D., at the right end of the time line, stands for the "age of machines." About two hundred years ago, when the "age of machines"



The pyramids of Egypt were built of stones that were dragged and lifted into place mostly by man power.

was beginning, man began to harness new sources of power. The "age of machines," in which we live, is sometimes called the "age of power." We cannot understand our ways of living unless we know something about these new kinds of power that man has harnessed to run his machines and do most of his work. The stories that follow this one tell some of the most interesting things about the coming of the "age of power."

A Time Line

Make a large copy of the time line in this story, and decorate it with small pictures to show its meaning in a more interesting way.

Write a Summary

Write a summary of Stories 2, 3, and 4. Make your summary one paragraph long. Be sure to tell the important ideas about muscle power, water power, and wind power.

Talking Time

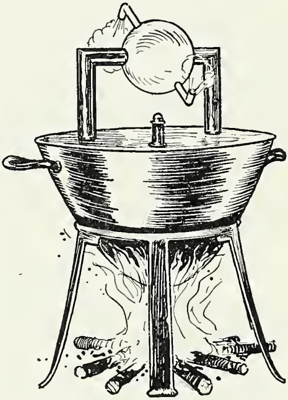
Maybe you can tell, or your teacher will read, to the class the story of Menes, "The Lazy Water Carrier" who found out how to use a lever to help him raise buckets of water from the Nile. Marion Lansing tells the story on pages 58–66 of *Man's Long Climb*. On pages 105–107 of the same book she tells the story of "The Water Wheel."

Look ahead to pages 365–366 for interesting books to read while you are studying this unit.

6

Making Steam Work

You know that it is harder to swim upstream than downstream, because the water pushes against you. When men made water wheels in Egypt they were really using the pushing power of the water in the Nile River as it flowed slowly downstream.



HERON'S STEAM ENGINE

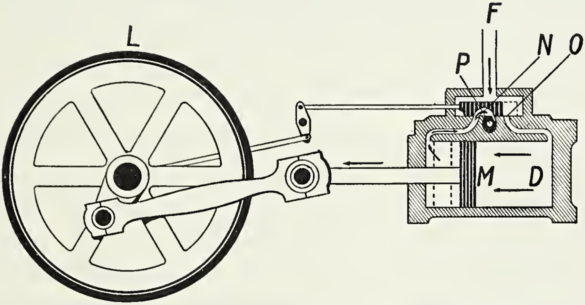
Only a few centuries after the first water wheels were made, the Greeks discovered another way to push by means of water. A Greek named Heron, or Hero, who lived in Alexandria, made a hollow ball with nozzles or little openings on it. Into this ball he passed steam from a small boiler. When the steam rushed out of the nozzles the hollow ball would spin around very fast. The Greeks, however, did not really know what a wonderful thing Heron of Alexandria had done when he made this first "steam engine." Even Heron himself never tried to make his steam engine do any work. To the Greeks it was just a toy, but the toy was really important because it first used steam to make something move. It was almost twenty centuries, or two thousand years, later that men found out how to make steam really work for them.

There is just one reason why steam can be made to work for man. When water is heated and turned into steam, the steam takes up about 1700 times more room than the water did when it was cold. One pint of water will make seven barrels of steam. And when the steam is shut up in a tight can or box, or "boiler," it pushes very hard in all directions against the sides. It pushes so hard that it sometimes bursts a boiler—even one made of very strong iron or steel.

In the stories that you have read about muscle power, you learned that men and animals can lift and pull and push heavy loads. Boys and girls of your age can push about one hundred pounds with the palms of their hands. Elephants can lift heavy logs and push circus wagons. But the steam shut up in a steel box can push ever so much harder than the strongest muscles in the world.

To make steam push a machine, a Frenchman named Denis Papin (dẽ-nē′ på-păɴ′) invented in 1690 an iron box called a *cylinder*. A cylinder is shaped like a round tin can. Inside the cylinder is a movable partition called a *piston* which is fitted tightly against the sides, yet loosely enough to slide back and forth. When a pipe leads the steam from a boiler into a cylinder, the steam pushes with tremendous force against the piston and drives it as far as it can go inside the cylinder.

When James Watt, in 1768, got the idea of pushing the piston first in one direction and then in the other with steam, he made the first successful steam engine. The steam is let in at one end of the cylinder and pushes the piston to the other end; then that steam is cooled and hot steam is let in at the other end of the cylinder. Back goes the piston! Back and forth it goes, with a power that will turn the heaviest wheels.

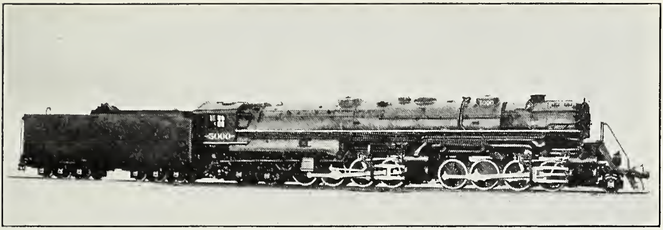


Drive Wheel (*L*) and Cylinder of a locomotive engine. In the cylinder *D*, steam coming from the boiler, through *F* and *O*, is pushing the piston *M* to the left. Used steam at the other end of the piston is escaping through openings *P* and *N*.

The first successful steam engines were used to pump water out of coal mines in England, and out of copper mines in New Jersey in our country. An American inventor, Oliver Evans, made a steam engine to run a dredging machine. Mud had settled in the Delaware River at Philadelphia and prevented ships from landing at the wharves. His steam engine was used in the work of scooping out the mud.

In the story about trains you read how other inventors put steam to work driving locomotives which pulled trains. Let us see how the steam does its mighty work. Imagine that you are standing beside the huge steam locomotive which is going to pull your train from New York to Chicago in 16½ hours. The cylinders look like steel barrels about a yard long and a little over two feet through. Inside the cylinder is the piston, ready to slide back and forth when the engineer opens the throttle and lets in the steam. The engine carries 28 tons of coal and 14,000 gallons of water to make the steam. The great drive wheels are taller than you are. In one turn they pull the train forward twenty feet. The big locomotive weighs 300 tons, and the train of twelve steel cars weighs 800 tons more.

How small the cylinders are, as compared with the big driving wheels and with the whole engine! Yet it is the pushing power of the steam in the cylinders that makes the whole train go. Each time the engine puffs it means that the steam has just given the piston a push of more than 50,000 pounds. When the train is going sixty miles an hour, the steam pushes the piston 528 times in one minute. Giving 528 pushes of over 50,000 pounds each is a tremendous amount of work. When inventors first made steam engines, they said that "this engine is as strong as a horse," or "as strong as three or four horses." Ever since then, engineers have measured the work of steam by what they call "horsepower." The horsepower of an engine tells how



Courtesy American Locomotive Co.

A Giant Freight Locomotive. It has two sets of drive wheels on each side.

many horses it would take to do as much work as the engine can do.

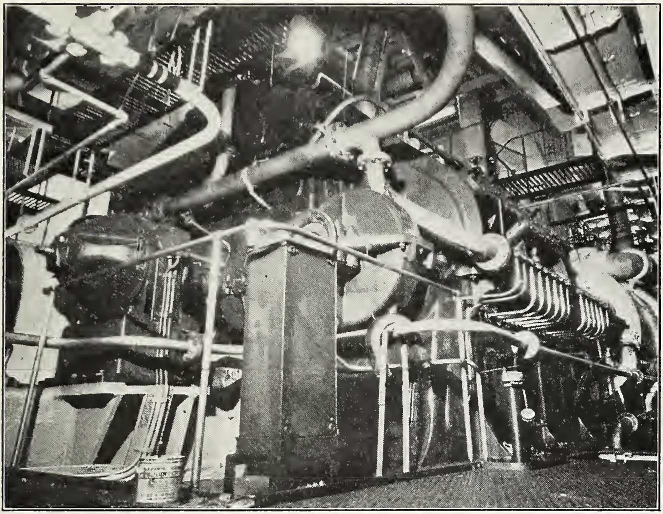
Your steam locomotive has more than 4,000 horsepower. Even if you could hitch 4,000 horses to the train, they could not pull it so fast as the locomotive, because no horse can run so fast. The locomotive is built to run as fast as the steam can make it go and, of course, steam never gets tired. The giant freight locomotives have more than 5,000 horsepower. You can easily see that steam engines are a great improvement over the muscles of man and animals.

In the story you read about boats, you learned how steam was put to work to take the place of sails and oars. When men first tried to use steam engines in boats, they had a great deal of trouble. The back-and-forth motion of the piston shook the boats so much that the passengers and crews thought the boats would break apart. The new source of power was not harnessed very well. In order to control the steam power used on a ship, a different kind of steam engine was invented. This new engine was the steam turbine. A turbine is an engine in which the steam rushes out of a nozzle against blades on the rim of a wheel, making the wheel turn very fast. In modern turbines the steam pushes against hundreds of little blades or paddles in a whole set of wheels. The turbine runs very smoothly and it does not shake the floor on which it stands. For this reason turbines can be used easily in boats, and the new source of power can drive ships on the seas. An Englishman, Charles A. Parsons, gave this valuable invention to the world.

If you could visit the engine room of the new ocean liner the *Queen Mary,* you would see the steam at work turning the great turbines. The steam can turn the wheels around more than 2,000 times in a minute. Try to see how many times you can move your wrist in ten seconds, as if you were turning an egg beater. If you can give your wrist 30 turns in ten seconds, that would be 180 turns in a minute. Then think of heavy steel wheels fourteen feet across being turned 2,000 times in a minute. That is how fast steam works for us.

The sixteen turbine engines of the *Queen Mary* produce 200,000 horsepower of work. To do this much work with horses, if they could be hitched together, you would have to drive a line of horses, two abreast, about 175 miles long.

Swift passenger locomotives, giant freight locomotives, and the mammoth ocean liners are the most



Ewing Galloway

In the Engine Room of a large ocean steamship. An engine like this does as much work as many thousands of horses.

wonderful examples of the work of steam. But we must remember that for every giant locomotive and ocean liner, there are hundreds of smaller steam engines working for us everywhere to make our ways of living more easy and convenient. Are men digging for a foundation or cutting away a hillside for a wider road? The snorting steam shovel tells you that they are. As soon as you step inside the furniture factory in your town, or the planing mill, or whatever kind of factory it may be, you are likely to hear the hum and roar of machines driven by steam.

Has your town a powerhouse for pumping the city water supply, another powerhouse for the street lights, or still another powerhouse for making gas? In these powerhouses in your town and in thousands of other towns, villages, and cities all over the United States, there are ever so many steam engines, large and small, doing all kinds of work for us. Thousands of factories and large buildings have steam engines to make their own electricity for machines and elevators. Unless the factories and office buildings are in cities which get electric power from waterfalls or big dams, they are sure to use steam engines.

Steam power is more useful than wind power because it is steadier and easier to control. It is more convenient than water power alone because the water must be used right at the waterfall or dam. You can take a steam engine almost anywhere in the world. The steam drills that were taken to Panama to work on the canal went through seven feet of solid rock in an hour. The steam shovels there dug out enough earth to make sixty-three pyramids as big as those in Egypt.

If you could fly over the United States and Europe, or over other parts of the world where there are large cities, you would look down on forests of chimneys and smokestacks. If you could fly over the oceans you would see the smoke from the funnels of many ships. Most of the lines of smoke rising skyward from tall chimneys and smokestacks mean that a fire is heating water, turning it into steam to push against pistons or

©G. A. Douglas, from Gendreau

A STEAM SHOVEL at work loading earth on a motor truck. The steam power harnessed in this machine does the work of many laborers.

turbine blades to drive machines. Steam does much of the hard work of the world, all because man found a new source of power and learned to harness it to work for him.

Talking Time

Choose classmates to pretend they are the inventors mentioned in this story. Let each inventor tell what he has done to give us steam power and how he has changed our ways of living.

Can you tell the class how a Fourth-of-July pinwheel is somewhat like a steam turbine?

For Your Notebook

Make a list of the ways in which steam power is better than wind power or water power.

Build a Model

Build a model of a cylinder. Explain to the class how the steam pushes the piston first in one direction and then in the other.

For Your Bulletin Board

Collect pictures of steam at work. In how many ways you can think of does steam help to make our ways of living?

7

Coal—A Magic Servant

You can easily hold in your hands two pounds of coal. Do you know that there is in those two pounds of coal enough power to do as much work as a man's muscles can do in a day? For hundreds and thousands of years men lived on the earth without knowing what a wonderful thing the black coal is that they sometimes saw sticking out of the sides of hills. When men learned to make steam engines to run machines they needed much good fuel. There was not enough wood to keep thousands of steam engines running and warm their houses too. Then it was that men began to use millions of tons of coal each year to help do the work of the world.

The coal that men have learned to use was made many millions of years before there were any human beings in the world. Long, long ago the climate of the earth was much warmer than it is today. On the warm swampy land many great trees and tall ferns grew. As the trees and ferns of some of the forests died, they fell into the swamps. In time, the swamps were covered with layers of mud and soil which turned into rock, while the dead forests turned into coal. For millions of years many of the layers of coal have remained buried deep in the layers of the earth.

It seems likely that more than two thousand years ago the Chinese were using some coal to heat their homes. Even the Britons of Roman times burned coal to keep themselves warm. For hundreds of years, though, wood was the chief fuel people used for cooking and warmth and for helping them make things. Ironworkers used charcoal to smelt iron ore when they made steel for the armor and weapons of the knights of the Middle Ages. Charcoal is wood that has been treated so that it will make much more heat than ordinary wood will make.

About three hundred years ago men had used so much wood that it was becoming scarce in England and other parts of Europe. In England laws were passed which said that ironmakers could no longer use wood. Some then tried to use coal. They were so unsuccessful that many ironworkers had to give up their little furnaces and find other work. Finally, in 1709 some workers discovered how to use coal successfully for smelting iron ore and making iron. About fifty years later, James Watt and other experimenters learned how to make steam work for man. In the years that followed, so much coal was needed to heat the boilers of the steam engines, that coal mining became a very important industry in many countries.

The United States, Germany, and Great Britain mine most of the coal used in the world. The table on the next page shows the average amount of coal each of these countries mines in a year.

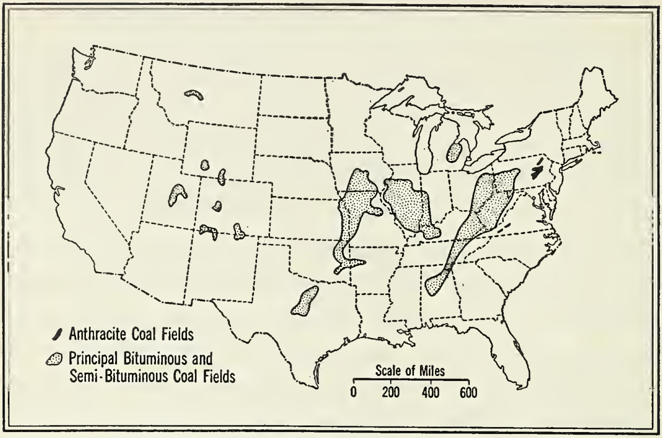
AVERAGE AMOUNT OF COAL MINED EACH YEAR

Country	*Tons*	*Country*	*Tons*
United States	402,000,000	Japan	37,000,000
Germany	284,000,000	Poland	34,000,000
Great Britain	241,000,000	Czechoslovakia	30,000,000
U.S.S.R. (Russia)	82,000,000	Belgium	28,000,000
France	53,000,000	Other countries	174,000,000

Of every 100 tons of coal mined in a year, the United States mines about 30 tons; Germany, 21 tons; Great Britain, 17 tons; Soviet Russia, 6 tons; many other countries, less than 5 tons each.

In some other lands—especially China, Australia, and parts of South America—there are large beds of coal which are not much mined as yet. It may be that in parts of Asia, Africa, and South America there is much coal that has not yet been found. The largest amounts of coal we know about today are in the United States.

In the United States there are three great coal regions: the eastern fields, the central fields, and the western fields. The eastern coal fields lie chiefly in Pennsylvania, Ohio, West Virginia, Kentucky, Tennessee, and Alabama. They produce about three fourths of the coal mined in the United States. In eastern Pennsylvania we find the hard, or anthracite, coal that is used to heat millions of homes in the eastern part of the United States. In the western part of Pennsylvania we find rich soft, or bituminous, coal. This coal is used in Pittsburgh and many other manufacturing



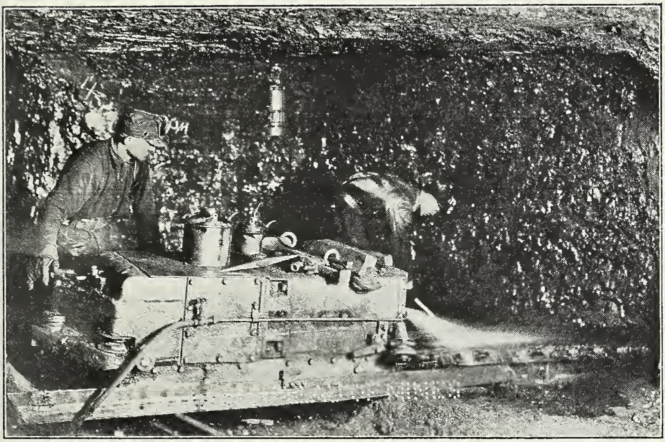
Coal Fields of the United States

cities that have grown up there because of the good supplies of coal and other things needed for making goods. In southern West Virginia and eastern Kentucky we find the bituminous mines that supply Virginia, the Carolinas, and some of the cities along the Ohio River with coal. In the southern part of the Appalachian Mountains there are bituminous mines that supply Birmingham and other southern manufacturing cities with the fuel they need.

The central coal fields of the United States lie chiefly in Indiana, Kentucky, Illinois, Iowa, Missouri, Kansas, Oklahoma, and Texas. These fields furnish bituminous coal to millions of homes in the Middle West and to the rapidly growing factories in such cities as St. Louis, Minneapolis, and Kansas City. Some of the coal from these central fields also goes to the cities along the Great Lakes, even though much coal from the eastern fields is carried in boats to these cities.

The western coal fields of the United States lie in Montana, Wyoming, Utah, Colorado, and New Mexico. The coal in the western fields is not much used as yet, but it may be that some day our factories and powerhouses will need this coal too.

The work of getting coal, the magic servant of men, out of the ground has taken the labor of millions of men. Often the work has been hard and dangerous. When coal mines were first opened in England, children who should have been in school or outdoors at play were often working long hours in the dark, damp



U. S. Bureau of Mines

AT WORK IN A COAL MINE

mines. In some places women, harnessed to the coal wagons, on their hands and knees dragged coal wagons to the opening of the mine. In all mines there was always the danger of accidents. Sometimes there were explosions or cave-ins which injured or killed workers.

Today, machines run by steam or electricity do much of the hard work that used to be done by the miners. Now the chief work of the miners is tending the machines. There are many safety devices and inspections which help to prevent accidents. Even though men have improved the ways of mining, the work is still hard and dangerous. We are much indebted to these workers for all they do in giving us our magic servant, coal. In our country today almost 600,000 men work at the mines getting coal for our factories, our railroads, our powerhouses, and our homes.

Now let us see some of the ways coal gives us the power we need to make our ways of living. Coal gives us between one half and three fourths of all the tremendous power that we use today. Oil, electricity made by the power of falling water, natural gas, wood, wind, and the muscles of animals and men give us the rest of our power. We can see the coal that heats many of our homes and schools. Every year each one of us uses much coal that he never sees. The engines of the long freight trains that bring us our clothes and food and many other things burn about 28 tons out of every 100 tons of coal mined in our country. The factories that make our clothes, mill our flour, and do countless other things use about 35 tons out of every hundred. Of the remaining tons left out of the 100, about 13 are taken for heating our homes and cooking our food, about 12 are used in powerhouses for making electricity, and about 12 are used for smelting iron and other metals, for making power to mine more coal, for running ships, and for many other things.

Besides making heat and steam power, coal gives us many other things. Out of one ton of coal men have learned to get almost a half ton of coke, 10,000 cubic feet of gas, two barrels of oil, and nine gallons of coal tar. Much of the coke is used in smelting iron. From coal tar there are made such things as dyes and medicines and perfumes. Who ever dreamed that a ton of coal could be made to do so much for us!

How much of this magic servant, coal, is there buried in the ground? It is thought that we probably have enough coal to last us a thousand years, though we are quickly using up our best coal. Even though we are rich in coal and have improved our ways of using it, we are wasting much of the power that could be put to good use. Indeed, it is possible that scientists of the future will find so many ways of using coal for making food, chemicals, and other things that the time will come when it will be thought very wasteful to burn coal. Today, however, it is the power in coal that is used, more than any other power, to cook our food, light our houses, heat our homes, run our railroads, and turn the wheels of the factories where the things we use are made. Don't you agree that the dirty black coal you see in the cellar bin is a magic servant of man?

For Your Museum

For your schoolroom museum bring samples of different kinds of coal and coke.

For the Bulletin Board

Find pictures of the forests which were turned into coal millions of years ago. Can you find pictures of men mining coal, and pictures of the ways coal works for us?

Drawing Time

Make a sketch or drawing showing how a coal mine is dug.

A Letter

Send a letter to a firm of chemical manufacturers asking for a chart of coal-tar products.

Talking Time

Tell what a piece of wood and a piece of coal might say about being used for fuel.

Look at the pictures all through this book, and count the number of them that suggest the use of coal.

8

How the World "Struck Oil"

Just as William Edwards reached the steps leading up to his home, his sister came running to the door. "Bill," she shouted, "I'm so glad you have come at last. Father is home from Pittsburgh and has brought the most wonderful lamp you ever saw."

William was surprised when he came into the house that November evening in 1857 and saw the shining new lamp that his father had bought. "What a bright light it gives!" he said as he stepped into the room.

"Yes," said his sister, "and see how much steadier the light is than any we have ever had before."

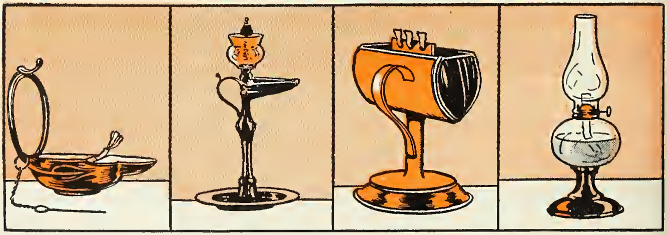
During supper the family talked about the beautiful new lamp. Mr. Edwards told how he had happened to buy it. "When I arrived in Pittsburgh," he said, "I went out to your Aunt Margaret's. She could talk of little but the wonderful new lamp that she had bought from Mr. Kier, the druggist.

"For a long time Mr. Kier has been selling medicine made from a kind of oil called petroleum," continued Mr. Edwards. "He, along with others, has been experimenting with ways of treating, or refining, the oil so that it can be burned in lamps. Many men have worked to improve lamps, but this one we have is the one that Mr. Kier is selling to burn his oil."

"Where does Mr. Kier get the oil to burn in his lamps?" asked William.

"Today I heard Mr. Kier explaining three ways in which we get oil," answered his father. "In some places oil rises out of the ground and forms pools. Not far from here, in western Pennsylvania, are lakes of water on which there is a scum of oil. Workers dip blankets into the pools, just as the Indians used to do, and wring the oil out of the blankets. Two men working steadily can sometimes wring out as much as forty-two gallons, or a barrel, of oil in a day. Men have learned also how to get oil from coal, and from it coal oil is made and burned in some lamps. I have heard that there are many coal-oil lamps sold in New York."

"Salt drillers, too, have found out how to get oil," continued Mr. Edwards. "When workers drill salt wells to get the brine for making salt, they often find oil mixed with the salt water. A few years ago drillers for salt were much disappointed with their finds when



These pictures show an old Greek lamp, a Roman lamp, a whale-oil lamp, and a kerosene lamp. How do these lamps compare with the lights used in your home?

along with the brine came ugly, smelly oil. The oil ruined the salt. Now, however, the salt drillers are beginning to want the oil more than they do the salt. If we could only find a quick and cheap way of getting the oil that is buried somewhere in the earth, we should never have to worry about good lighting in our homes."

The world did not have to wait long to find a cheap and easy supply of oil. At the time William Edwards's father bought the fine new oil lamp from Samuel Kier's store, a company had already been formed to search for oil in Pennsylvania. The members of the company thought, "Men can drill wells to get salt water which has a little oil mixed with it. Why can't we drill wells far down into the rocks where the oil doubtless is hidden, and pump up the oil?"

The company hired Colonel Edwin L. Drake to take charge of drilling their wells. Drake had a difficult time persuading men to work for him on the well that he started to drill near Titusville (tī′tŭs-vĭl), Pennsylvania. People laughed at him and said that he would end up in China or in some other place on the opposite side of the world. In spite of ridicule and discouragement, Drake worked for two years trying to drill a well that would reach the "pools" of oil that he felt sure were hidden in the ground.

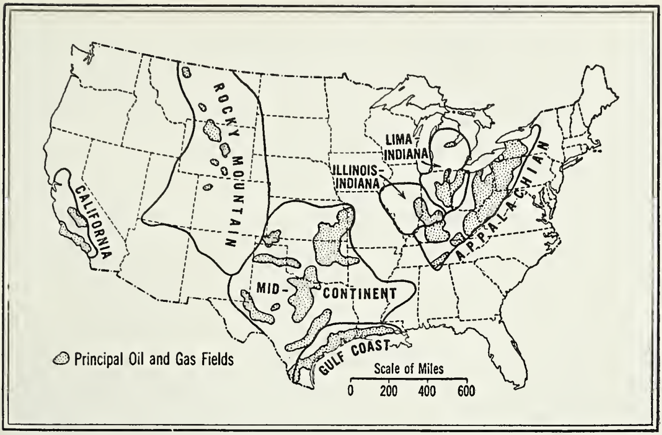
In August, 1859, there was great excitement throughout western Pennsylvania when Drake at last "struck oil." His well had struck a "pool of oil"—that is, a layer of oil-holding rock—hidden far below the

The Bettmann Collection

Drake's Oil Well. From an old photograph.

earth's surface. Excitedly he put a pump in the well, and the first day twenty-five barrels of oil were brought to the surface. Everybody was wildly excited. It was as if gold had been found—black, oily gold. Soon hundreds of wells were dug in Pennsylvania, some of which were successful, and some not. In other parts of the country, too, oil was discovered.

By studying the map on page 325, you can see that there are seven oil and gas fields in the United States: the Appalachian Field, the Lima-Indiana Field, the Illinois-Indiana Field, the Mid-Continent Field, the Gulf Coast Field, the Rocky Mountain Field, and the California Field. Today we get most of our oil from



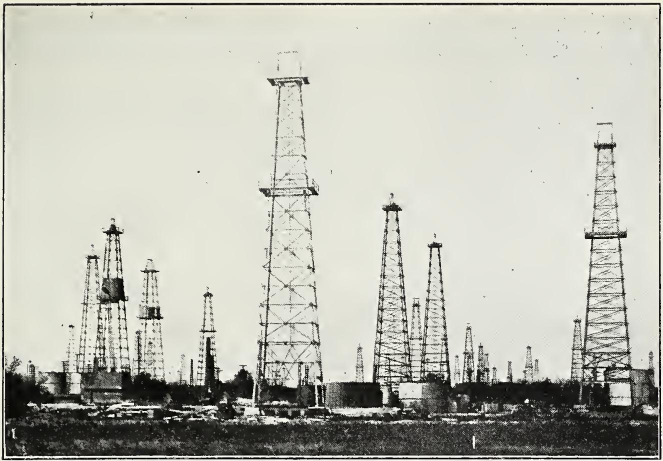
Oil and Gas Fields of the United States. Some parts of the shaded areas yield both oil and natural gas; some, only oil; some, only gas.

the Gulf Coast Field and the California Field. Mexico produces great quantities of oil, and in the Eastern Hemisphere the region around the Caspian Sea is another important field. Southwestern Asia also has important oil fields. The production and use of oil has become world-wide since that August day in 1859 when Drake at last "struck oil."

For several years the oil producers were troubled with the problem of carrying the oil to the places where it was to be refined. Shipping oil by river rafts, by wagons, and even by railroads was awkward and expensive. It did not take the oil men long to think up a way of transporting oil cheaply and quickly. Soon after the discovery of oil in Pennsylvania, some of the companies began to lay pipes to carry the oil from the wells to the refineries. The refineries are the great "factories" where petroleum is made into gasoline and many other useful products. Today nearly 100,000 miles of pipe laid underground carry thousands of barrels of oil every day from the oil fields to the refineries located in or near Philadelphia, Bayonne (bā-yōn′) in New Jersey, Cleveland, Chicago, Houston (hūs′tŭn) in Texas, San Francisco, and other places.

When the refiners treated petroleum to get just the right kinds of oil for lamps and for oiling machinery, they had left a part of the oil, called *gasoline,* for which they could find little or no use. Then in the 1890's came the improvement of the "internal-combustion engine," the engine that today runs our automobiles, our trucks, our tractors, and our airplanes. It was found that gasoline furnished the best power for running the internal-combustion engine. With the increase in the number of automobiles, trucks, and airplanes, there came also a tremendous increase in the production of oil and gasoline.

Before August, 1859, the oil industry was carried on by means of blankets and a few salt wells. Today the oil industry has grown to be one of the most important in the world. It is an industry that gives work to thousands of people scattered throughout the world. Some of the workers search in many places for new stores of oil, while other workers are busy drilling wells, and still others are pumping crude oil to the refineries.



Sinclair Refining Co.

OIL WELLS near Oklahoma City, in the Mid-Continent Field. The derricks shown were used in drilling the wells.

If you could visit some of the busy refineries of our country you would find the workers there doing wonders with crude oil. The thing that refiners want most, and get the most of, is gasoline for the millions of gasoline engines we use today. Another important product is the lubricating oil that keeps all kinds of motors running smoothly and easily. Many kinds of good lubricating oil help to make the ways of living in the age of machines. Kerosene for lamps and stoves, and much fuel oil for heating homes and other buildings and for propelling ships, are other important products obtained from crude oil. About five hundred other products also are made from what is left of the black, sticky oil that goes into the refineries. Among them are coke, asphalt, vaseline, candles, mineral oil, and sealing wax.

At the refineries there are experimenters working to improve the products that are obtained from oil. They have worked, and are still working, especially to increase the amount of gasoline that can be made from each barrel of oil. They work also to increase the power of the gasoline that runs the many millions of gasoline engines in the world.

Outside the refineries many workers are busy selling the products obtained from oil. There is the work of

Fairbanks

Many men are busy selling gasoline by the gallon. Do you know how it is measured?

distributing gasoline to countless gasoline stations and then selling the gasoline to automobile owners, shipowners, and pilots of airplanes. Many oil trucks are kept busy carrying oil to the homes where it is used as fuel. Doubtless you can think of many other ways in which the large oil companies and their thousands of workers furnish power for pleasure, work, and warmth.

Oil is a liquid buried deep in the earth. Is there so much of it that it will last forever? Some scientists think that we have already used about half of the oil and gas supplies that lay buried deep in the earth when Drake first struck oil. Much of the oil and gas that we have taken from the ground we have wasted. But we have gradually learned more about how to get oil from the ground without wasting so much of it. We have also learned how to increase the power we get from it today. Automobile engines today run on less gasoline than they had to have a few years ago. It is thought that some day a gallon of gasoline can be made to furnish enough power to drive a car many more miles than it does today. If we use oil carefully we can hope to make it last longer and give us more power.

As William Edwards grew up he saw many changes in our ways of living. He saw the sticky black oil that the salt drillers had disliked become one of our most important sources of power. Oil is a magic power that plays a very important part in making our ways of living today.

Acting Time

Perhaps two pupils would like to show the class how the Indians used to get oil from ponds.

You and your classmates might like to represent the different products made from oil. Each can tell how the product he represents is used in the world.

Finding Out

Can you find information about drilling oil wells in the encyclopedia and give an oral report on what you learn?

Can you find out how many gasoline filling stations there are in your neighborhood? Where do they get their gasoline?

Can you find information in the encyclopedias about the way the refineries get different products from oil?

Word Study

Use each of these words in a sentence: *petroleum, kerosene, gasoline, refinery.*

For Your Bulletin Board

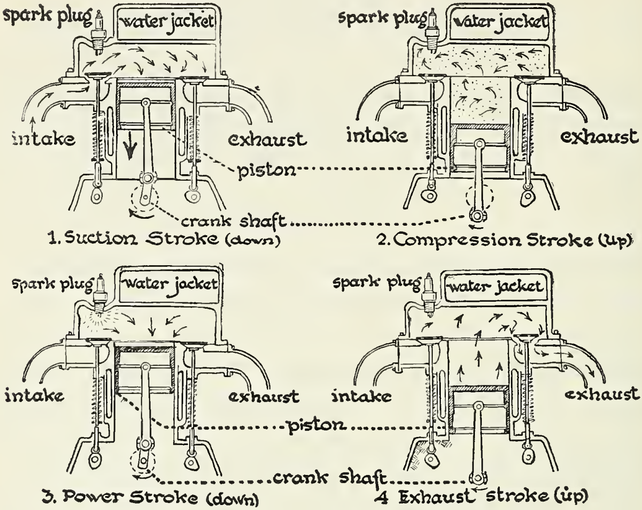
Collect pictures of oil wells and refineries. Arrange an exhibit of pictures of oil lamps.

9

A New Kind of Engine

If you lift up the hood of your automobile and look at the engine, you see a puzzling collection of different parts. You probably know where the cylinders are, because you can see the spark plugs that belong with them. Of course you see the fan and the fan belt in front of the engine and the gearshift just behind it. You have heard people talk about the "distributor," the "generator," and the "coil," but these engine parts are probably a puzzle to you, as are the different pipes and wire connections. You may wonder how the garage man knows what to do when there is engine trouble. It would take a long time before you could learn to repair an automobile engine, but you can easily learn what makes it go. The story of the gasoline engine is one which you should know, because this new kind of engine has made many changes in our ways of living.

About a hundred years after James Watt made steam drive pistons back and forth, several inventors, among them Gottlieb Daimler (page 121), made engines which ran by gasoline. Instead of having steam push the piston, they had gasoline mixed with air explode inside the cylinder. The exploding gasoline gave the piston a very strong push. Before Daimler, some inventors had tried touching off gunpowder inside the cylinder, but they could not put in new charges of powder fast enough to keep the engine going.



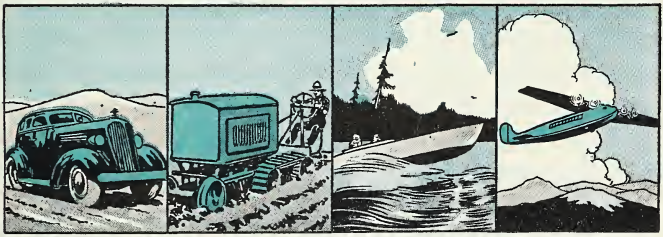
1. Suction Stroke (down)
2. Compression Stroke (up)
3. Power Stroke (down)
4 Exhaust stroke (up)

These diagrams show the working of a gasoline engine.

In the last two stories you have read, you learned about coal and oil, and also something about gasoline as a fuel. When you stand beside a great passenger locomotive you see the heavy load of coal, and the big water tank, and you feel the heat from the firebox and the boiler. None of these are necessary in a gasoline engine. A pound of gasoline gives from one and a half times to nearly twice as much heat as a pound of coal. Instead of shoveling the heavy coal, the driver has only to "step on the gas" to feed the right amount into the engine. The gasoline engine does not waste nearly so much heat as the steam engine does. It is cleaner and more convenient in many ways. Most important of all, this new kind of engine is very light in weight compared with the steam engine. For this reason, as you have read, it can be used in airplanes and dirigibles.

You may be interested to learn that the piston-strokes in gasoline engines are much quicker than in steam engines. In a locomotive going at the speed of sixty miles an hour the steam pushes each piston 528 times in one minute. In each cylinder of your automobile there may be as many as 1500 explosions in a minute. An eight-cylinder engine gives your car about 12,000 pushes in each minute. That is why the car runs so smoothly.

Besides our automobiles, there are many thousands of gasoline engines that drive launches, fishing boats, and small freight boats through the waters of our lakes and rivers and along our seacoasts. You can buy a



Gasoline helps to make many of our ways of living. For example, it runs automobiles, tractors, motorboats, and airplanes.

little gasoline engine that you can put at the stern of a rowboat to drive you quickly and easily wherever there is quiet water. Just as the automobile takes people to vacation places seldom reached by horse and buggy, the motorboat takes thousands of us to summer camps that were never reached by steamboat or are too far away for rowboats.

Besides giving us automobiles and motorboats and airplanes, the gasoline engine helps workers in every part of the civilized world. In your city some water pipes are being laid in a new street. You hear the "putt-putt-putt" of the small gasoline engine that pumps the water out of the trench. Your town hall is being cleaned on the outside with a sand blast. It is a gasoline engine which does the work. The foundation of an office building is being built deep in the ground. One of these new engines mixes the concrete. A gasoline engine drives a caterpillar tractor over a wheat field in Minnesota; another runs a threshing machine on a farm in Iowa; another turns a buzz saw in a lumber mill in Georgia. All over the world, there are thousands of gasoline engines at work for us. They take the place of the muscle power, the windmills, and the slow-moving water wheels of long ago.

In past years, some very large and powerful engines have been built, which ran by natural gas and by gas made from coal (producer gas). The gas exploded inside the cylinder. Some of these big engines had as much as 2,000 horsepower. They were used in powerhouses, factories, and mills. But today, their place is being taken by another kind of engine which is driven by the burning of fuel inside the cylinder.

The new engines burn oil as fuel instead of gas or gasoline. Fuel oil is cheaper than gasoline. The name of the inventor of these engines is Rudolph Diesel (dē′zĕl), and we call them Diesel engines.

Have you seen one of the new "aluminum" streamlined trains? Try to remember how the front car looked. You cannot see much of the engine from the outside, because the streamlining hides everything. The Diesel engine inside looks like a very big automobile engine. If anything, it looks even more simple. It is certainly very simple compared with the steam locomotive. The whole engine car weighs only 18 tons, although a large locomotive weighs 300 tons. It can carry oil enough to run 1,200 miles, or 20 hours, although a locomotive can run only 9 hours with its load of coal and water. The Diesel engine can keep up a speed of 90 miles an hour and can go as fast as 120 miles an hour. A Diesel engine burned only $80 worth of fuel to haul a train of six cars from New York to San Francisco. The coal burned in a locomotive for such a trip would cost several times as much.

In the world's largest dirigible, the *Hindenburg,* there was a kind of Diesel engine that could drive the propellers with 4,400 horsepower. Diesel engines are being used more and more on ships and trains. You can see that these, and other kinds of engines which burn the fuel inside the cylinders, have given us a new source of power which we use on land, on water, and in the air. Can you think of the many ways in which this new power has changed our ways of working and living?

For Your Notebook or Bulletin Board

Find pictures of different kinds of gasoline engines. Put them in your notebook—or on the Bulletin Board.

Two Lists

Make a list of the different kinds of work done by gasoline engines. Begin the list with the kinds of work which you have seen gasoline engines do. Put this list in your notebook.

On the left side of a page in your notebook make a list which tells how gasoline engines are better than steam engines. On the right side make a list telling how steam engines are better than gasoline engines.

Word Study

Be sure that you know the meaning of these terms: *cylinder, gasoline engine, piston, Diesel engine.*

10

How Electricity Was Harnessed

Michael was a blacksmith's son. He was a poor boy and worked as an apprentice in a shop where books were bound. There his work was to cover books on the outside, but Michael always looked inside the books as well. He soon began reading the books, at least those that interested him the most. These were the books about science.

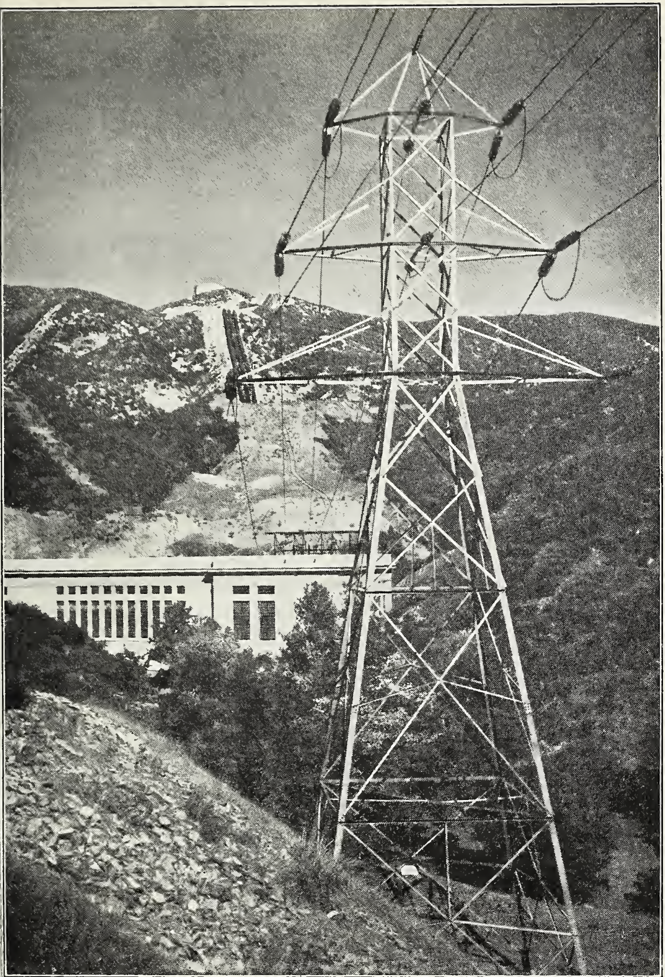
When Michael grew to be a young man he attended some lectures given by a great British scientist. Michael carefully wrote down what he heard at the lectures and later sent what he had written to the great scientist. He asked if he might work in the scientist's laboratory instead of in the bookbindery. The scientist was so pleased with Michael's carefully written notes that he granted the request. He sent his private coach with a footman in livery to Michael's home to bring the young man to him. That was the beginning of the work and discoveries of the world-renowned Michael Faraday (făr′*ȧ*-dā), one of the men who has done most to harness electricity.

At that time the only way to send electricity through a wire was to have both ends of the wire connected with a battery. That is the way electricity is sent through some doorbell wires and through the wires in your automobile. Batteries large enough to send strong currents of electricity are much bother and are expensive to run. Faraday discovered a new and better way to send electricity through a wire. It was so simple that you would hardly believe it. This is what Faraday did.

You know that a magnet is a piece of iron or steel that will pick up tacks or nails and other bits of iron. Faraday had a magnet and a coil of copper wire. He found that when he turned the coil of wire around in the air near the magnet, he could make electricity go through the wire. Then he made a simple machine to turn the wire and he got a steady current of electricity as long as he kept the machine going.

Faraday did not get a very strong current with his one magnet and one coil of wire. But ever since he made this important discovery, inventors have been building machines with more magnets and more coils. They have also made the machines turn very rapidly. In this way they have succeeded in sending very strong currents of electricity through wires and cables. They can also send the electricity over very long distances.

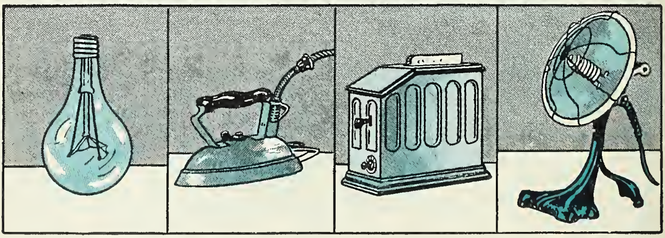
The machines which start the electricity are called *dynamos,* from a Greek word that means "power." The electric power sent into one end of a wire will run a motor or light a bulb at the other end of the wire. That is what makes electric power so convenient. The power can be used wherever we can run a wire. Let us see how convenient and useful this is.



The tower seen here supports wires carrying electric current from a powerhouse to Los Angeles.

In many homes, electric power is ready to give light in every room and to run a radio, vacuum cleaner, refrigerator, washing machine, toaster, coffee percolator, cake mixer, clocks, bathroom heater, and often a sewing machine and a kitchen range.

In great cities a motorman throws a switch and a big trolley car full of people rolls along the street, or a long subway train dashes away from the platform. In large buildings an elevator man moves a lever and a carload of persons is lifted to the top floors in a few seconds. In some cities engineers press buttons and the electric passenger and freight trains move swiftly in and out of the cities without the noise and dirt of the steam locomotive. In mills and factories, hundreds of different kinds of machines hammer, drill, roll, press, cut, grind, spin, and weave to do the work of making goods for us. We must remember that there are still thousands of machines driven by steam, but the number that run by electricity is growing larger every year.



Electricity is used in many ways. Can you draw more pictures, like these, to show the uses of electricity? Can you have an exhibit, at school, of ways we use electricity?

Far away in Panama, at the Gatun (gä-to͞on′) Locks (page 154), the turning of a switch opens one of the giant gates of the lock. Each gate is 82 feet high, 65 feet wide, and 7 feet thick. The touch of the engineer's hand moves 600 tons of steel and concrete silently and swiftly.

Engineers use two kinds of power to make electricity —steam power and water power. In New York City there is one power plant where the steam-driven turbines make 1,000,000 horsepower of electricity. Perhaps you will find the water-power plants more interesting. They are usually at a big dam or a natural waterfall. The Conowingo (kŏn-ō-wĭng′gō) Dam on the Susquehanna River in northeastern Maryland is more than 100 feet high. About 45,000 cubic feet of water a second flows, from openings in the dam, through seven great water wheels, producing nearly 400,000 horsepower of electricity. Each of these water wheels is about 18 feet across and weighs about 120 tons. Yet the water power makes it spin like a top and turn large dynamos to make electric power. The electricity is sent to farms and villages near by and to cities many miles away.

Another power plant, at Keokuk (kē′ō-kŭk), Iowa, sends electricity to St. Louis, 137 miles away. Streetcars, street lights, and many machines in San Francisco are kept going by electricity made in dynamos 160 miles away at the falls of the Feather River in northern California. Another great region, three hundred miles east and west and one hundred miles north and south, is supplied with electric power from the plant at Niagara Falls for lights, mills, factories, trolley cars, and all the convenient machines used in people's houses.

As you travel in an automobile through the country, you often see the high steel towers which hold up the cables carrying these strong electric currents. The network of these cables stretches far and wide from power plants to cities and to farms. Electric power has given us many new and better ways of living.

A Trip

Perhaps your teacher will take you to see a power plant in your community. If there is a dam where electricity is generated near your home, try to visit it.

Using the Map

On an outline map of the United States place colored dots to show where six important electric power plants have been built.

Collect pictures of some of the most important dams built for electric power and paste these on your map.

Know These Words

dynamo, electricity, magneto, generate, turbine.

Making a List

Make a list of the advantages of electric power over steam and gasoline power.

11

A Power Chart

From before 2000 B.C. to about 1750 A.D. men depended on muscles, winds, and water for power. Since 1750 has come the "age of machines" and men have succeeded in harnessing new sources of power. What does the chart below tell you about the sources of power and their uses?

Kind of Power	*Engines Which Harness the Power*	*Uses for Power*
Muscles of men and animals		Lifting, transporting, etc.
Wind	Sails Windmills	Transporting Grinding grain
Steam	Steam engine driven by coal	Locomotives; heavy factory engines
Gasoline explosions	Internal-combustion engines	Light engines, automobiles, airplanes, etc.
Electricity	Motors	Trolley cars, factory machines, household appliances, lights, etc.

What uses have you made of these kinds of power during the last week?

Answering Questions

In your notebook write the answer to the last question on page 343. You may have five parts in your answer, one for each kind of power.

A Testing Game

Copy in your notebook or on a sheet of paper the numbers of the words or expressions in the column on the left. With each number match the letter on the right that belongs with it. Write out the five correct statements.

1. One horsepower
2. Diesel engine
3. Water turbine
4. Steam turbine
5. Electric power plant

(*a*) Best kind of engine for ships
(*b*) Used to turn dynamos in large hydroelectric plants
(*c*) Sends power to be used many miles away
(*d*) Is power enough to lift 550 pounds 1 foot each second
(*e*) Burns wood for fuel
(*f*) Is caused by the sun
(*g*) Kind of engine used in streamlined trains

Make a Time Line

Look at the Time Line on page 300 which shows the coming of the "age of machines." Make a time line of the "Harnessing of Power."

12

More Power for All

Do you remember the story of Sokar harnessing the Nile River and making it work for him? The first water wheel in Egypt freed many straining muscles from much hard work. To get more power from rivers, men have been making bigger and better water wheels ever since those early forgotten times. In the Isle of Man, near England, the engineers made a water wheel 72 feet high. Today the giant water turbines give us still more power because the inventors in many countries have studied and made plans to get all the power they could from falling water.

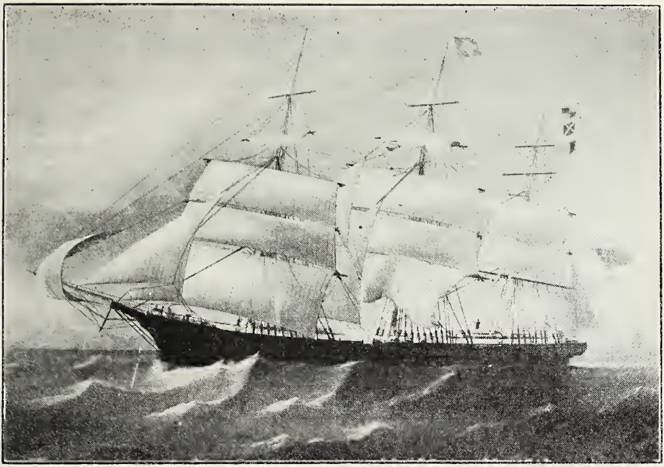
From earliest times, too, the builders of ships have taken power from the winds to sail their boats through the water. The wind power they were able to catch in their sails was greater than all the power they could get from the strong arms of the galley slaves tugging at the oars.

You have read about the Dutch windmills and how they took power from the breezes to pump water and grind grain. Since the first windmills were built, the engineers have kept on trying to capture more and more power from the wind. In the United States they made steel windmills that were twelve or sixteen feet across. With these machines they reached high into the air for power to pump water, to cut fodder, and to turn the wheels of machines.

Still other inventors kept on hunting for more power. You know how James Watt used the heating power of coal to turn water into steam and how he put the mighty power of steam to work in his steam engine. In the years which have passed since then, the engineers and inventors have been able to get more and more power out of steam by building better engines and steam turbines.

All the people who have been making experiments and inventions with water power, wind power, and steam power have really been carrying out a great plan of work toward the same goal. They all want to get more power to turn wheels, to make goods, and to carry goods and people quickly from place to place. In carrying out this plan year after year, the engineers have had many hard problems to solve. They have not solved all of them yet.

One of the hardest problems in getting more power is not to waste so much of it. Sokar certainly spilled a good deal of water back into the Nile, and most of the water that flowed under his wheel did not touch the paddles on it. Much of the wind blows past the sails of ships and through the wheels of windmills without being caught. The men who sailed the ships did learn to catch more of the power in the wind by handling their sails more skillfully. Instead of having just one big sail, as the ancient sea rovers



An American Clipper. By using many sails instead of one sail, men learned to make sailboats work better.

did, they found that many smaller sails were better. The speed of the clipper ships, in the years before the steamboat, showed that men were quite successful in harnessing the wind.

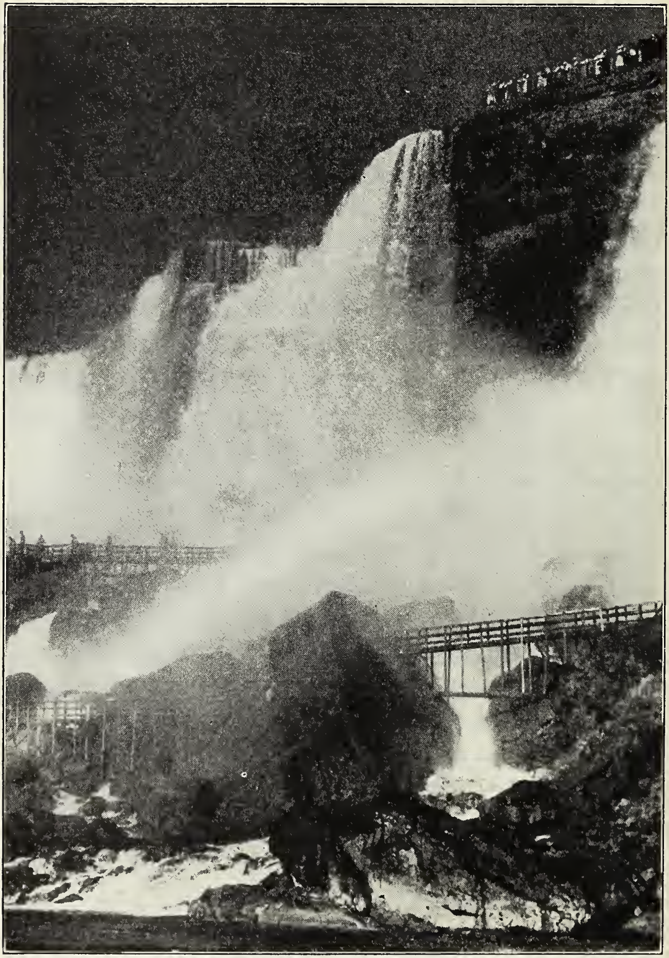
With coal and steam there is still more waste. Turn back to the picture of the locomotive. Let us see some of the waste and leaks of power. In the first place the locomotive must carry its heavy load of coal. We carry coal to burn it and at the same time we have to burn some of the coal to carry the rest of it for power. We cannot use *all* the heat from the coal to make steam in the boiler. Heat is wasted because the whole locomotive gets hot like the steam radiator in a house. Much heat goes up the smokestack. Steam is wasted after every stroke of the piston. Some of the coal itself is wasted because not all of it is burned. After all these losses in heat and power in locomotives, we get only from one sixteenth to one eighth of the power which we ought to get with a "perfect" machine and "perfect" fuel. Steam engines in factories and powerhouses do not rush through the cold air at sixty miles an hour, and they do not have to carry their fuel. The best of these factory engines give us nearly twice as much power for work as the locomotives do.

In the story about oil you have read how the new fuel gasoline was discovered in this great hunt for more power. Gasoline has more heating power than coal. With engines that burn gasoline, the inventors were able to capture more power than they could get from coal. While automobiles must carry their load of gasoline, the drivers do not have to use much power to feed the fire. About twice as much of the total power of the gasoline can be made to drive the automobile as we can get from the coal to drive the locomotive.

The steam turbines are the best engines that use the power of steam. They get the greatest amount of power out of the steam to turn the wheels of machines and the propellers of ocean liners. The Diesel engines are the best engines that burn their fuel inside their cylinders. They capture the greatest amount of the total power in the oil to do work. Steam turbines and Diesel engines are two important steps in the great plan of inventors to get more power. They are really victories over the waste of power.

Another victory is the successful harnessing of electricity. You have read a story about that. Because the power of electricity could be sent through wires for one or two hundred miles, many cities and farms have had all the benefits of more power without using steam and gasoline engines. We can get more power with less waste if we have one large steam engine or a turbine in a powerhouse to drive great dynamos. Then we can send the electric power all over the surrounding country. One big engine takes the place of hundreds of smaller engines in the city houses and on the farms.

Today we have something which is even better than one big steam engine to drive the dynamos for electricity. It is our new way of capturing the power of water. It is the way that we have carried out the idea of Sokar and his crude water wheel with its buckets. We have the water turbines. They use the power of falling water to run our largest dynamos. At our great waterfalls and dams the constant supply of water gives us more power than we have ever had before. We do not have to build furnaces and put up steam engines or haul coal and oil to burn in them. The water is always there, day and night, month after month, and year by year.



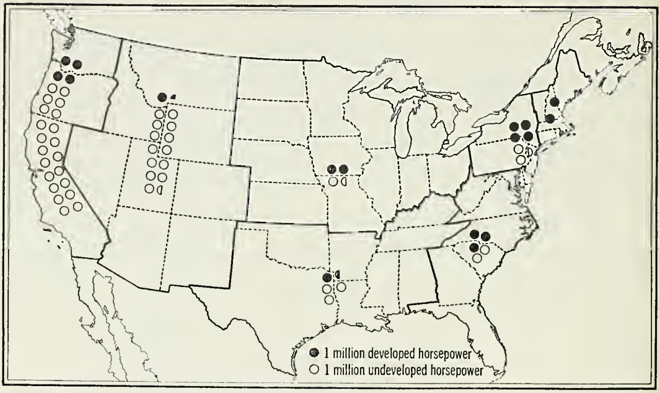
Gendreau

Part of Niagara Falls. We have learned how to harness the mighty power of these great falls and to send it to many cities.

When we use water to turn turbines we capture as much as nine tenths of its power. There is much less waste than in steam and gasoline engines. This is another reason why water gives us more power than we have ever had before. Of course it costs a great deal of money to build dams and powerhouses and to put in the huge turbines. But after this has been done, the water, used as the source of power, costs nothing unless there is a tax for using it.

Getting more water power and turning it into electric power for all the surrounding regions is our great plan for the future. Many rivers and waterfalls have already been harnessed to give us this new power for city lights, streetcars, machines in factories, elevators in high buildings, and all the convenient electric machines we use in our homes. We shall probably use more and more water power turned into electricity as the years go by.

The map on page 352 shows the great amount of water power that is used, or may be used, in the different sections of our country. There are now, as you know (pages 341–342), great powerhouses, or power plants, as they are called, on the Susquehanna River at Conowingo, Maryland; on the Mississippi River at Keokuk, Iowa, and at Niagara Falls in New York. But those are only three of the many, many places where there are large power plants. Among the others are Minneapolis, Minnesota, on the Mississippi River, and McCalls Ferry, Pennsylvania, on the Susquehanna.


● 1 million developed horsepower
○ 1 million undeveloped horsepower

WATER POWER IN THE SEVEN SECTIONS OF THE UNITED STATES. Each solid circle shows 1,000,000 horsepower in use, and each open circle shows 1,000,000 horsepower not yet in use, but available for future development.

Many rivers in New York and New England are used for power of this kind.

In other sections there are great power plants at the Norris Dam, the Wheeler Dam, the Wilson Dam and other dams on the Tennessee River; at the Roosevelt Dam on the Salt River near Phoenix, Arizona; at the Parker Dam and the great Boulder Dam (page 298) on the Colorado River; at Big Creek, California; at the Grand Coulee Dam on the Columbia River in Washington; and at Spokane Falls, Washington. On the Missouri River at Great Falls, Montana, are power plants that make power for use in mines and on railroads that cross the mountains. As the map here shows, too, there is in our country much more water power, possible for future use, in the western sections than in the east.

In Europe there are engineers who are capturing this new kind of power from the mountain streams of Switzerland, Italy, France, Sweden, and Norway. The world-wide hunt for more power has reached Japan. In future years many more waterfalls will be put to work and many more dams will be built.

This story of man's hunt for power tells us something that is even more important for us to remember than the wonderful machines and the places where power plants are located on our rivers. The story tells us that primitive man had no power to help him in his ways of living except his own muscles. Next, man had as much power as he could get from the muscles of the animals he tamed to work for him. Then he gained more power by finding ways in which to use winds and streams of water. After many centuries the steam and gasoline engines gave him still more power. Every engine gave him the power of several horses to do his work. An automobile may give him the power of 50, 60, or 80 horses. A locomotive gives him the power of 4,000 or 5,000 horses. The *Queen Mary* gives him the power of 200,000 horses. Finally, Boulder Dam gives him the power of 1,800,000 horses.

Most helpful of all is the fact that we can all share in these great gifts of tremendous power. Perhaps primitive man shared the powers of his muscles by helping a neighbor or lending an animal. Today, when you turn on an electric light, or your radio, you share the power of our machine age. Families, factories, towns and cities, farms and highways all share in the gift of more power which has changed so many of our ways of living. Future gifts of still more power may bring us further changes of which we do not dream today.

Writing a Summary

Write in your notebook a summary of this story in one paragraph.

A Poster

Draw a poster showing how the different machines and engines told about in this story have given us more and more horsepower.

Playing Characters

Perhaps the members of your class would enjoy pretending they are the following people. Let them dress like the characters and tell how they helped to give the world more power. You will want to consult the encyclopedias for more information about these men.

James Watt
Denis Papin
Edwin L. Drake
Gottlieb Daimler
Michael Faraday
Rudolph Diesel

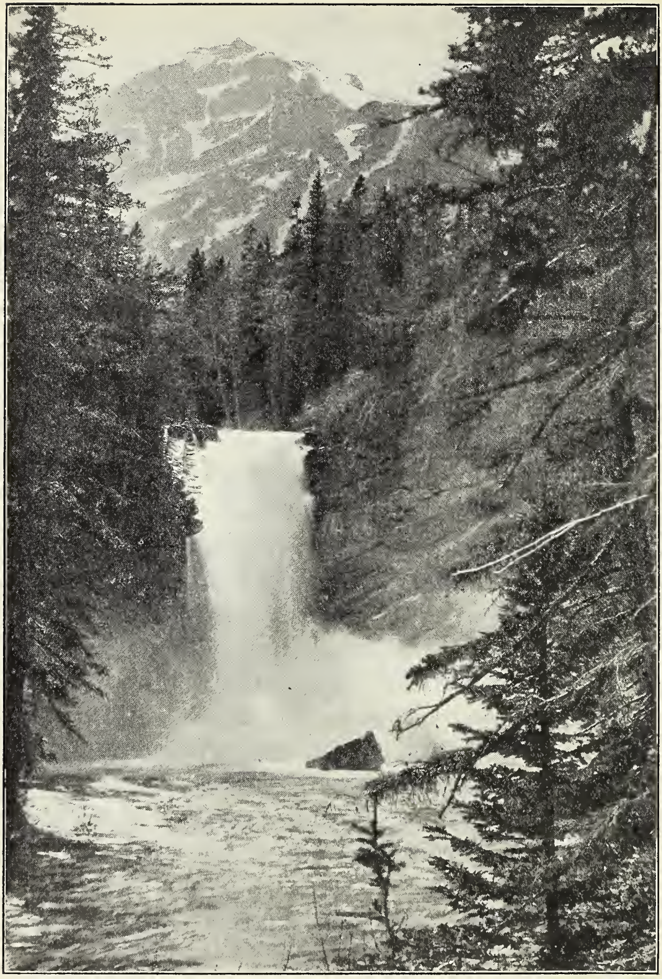
13

Hunting for New Kinds of Power

By this time you can think of ever so many ways in which power is very important in our lives every day. You have learned that man has discovered many different ways of capturing nature's power and harnessing it to do his work. You know that because man has learned to control some of nature's power, we now have better ways of living.

As you read the stories about the river that turned the water wheel, the wind that turned the windmill, the steam engine that pulled the train, and the giant dynamos that produce electricity, did you realize that the power in all of them really comes from a single source, the sun? You are probably wondering how that can be possible. It happens in this way.

When the sun shines on the waters of the seas, and the rivers and lakes, its heat turns some of the water into vapor. The water vapor is as light as air and it spreads upward high in the sky. Later some of it falls on land as rain and snow. Then the sun melts the snow again. Many streams of water flow with great force down the sides of mountains and through the valleys below. In every drop of this water there is power. So you see that when men harness water, they are really using power from the sun.



©Hileman

Snow-capped Mountain, Trees, and Waterfall in Glacier National Park, Montana.

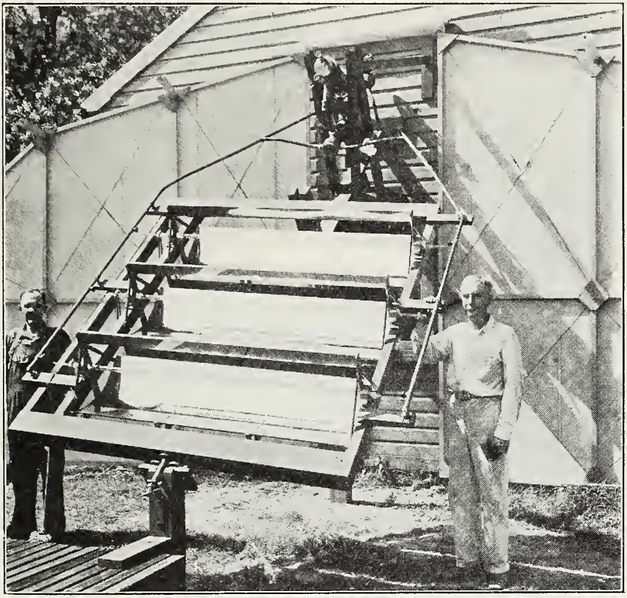
You may be thinking that you understand about water, but what about the power of the wind? You may think the sun has nothing to do with that! But it has. The heat of the sun warms the air in one place. As you know, heated air is lighter than cold air. Cool air pushes in, under the heated air, and causes what you and I call wind. When men use the wind to sail their ships or turn their wheels, they are using power from the sun.

It is not only through the wind and the water that men are able to use the power of the sun. Of course you know that the heat of the sun makes the plants and trees grow. They could not live without the warmth from it. So whenever wood was burned to make steam to push an engine, it was the heat from the sun which was stored up in the tree that really pushed the engine. You remember that coal was made from trees millions of years ago. Scientists believe that petroleum and natural gas come from the bodies of plants and animals likewise buried deep in the earth millions of years ago. So when coal or oil is used to make steam and electricity, men are using power that was stored up from the sun millions of years ago.

You may think it strange that if the sun is the source of the earth's power we do not use the power of the sun directly from its rays instead of burning fuels like coal and oil to make power. That is just what many engineers have tried to do. The first man to try to use the direct rays of the sun for power was John Ericsson. He was afraid that the world's supply of coal would run out some day and men would have to find a new source of power. A mirror three feet square gets enough heat from bright sunshine to make one horsepower if we could catch all of it. Ericsson experimented for a large part of his life with a sun engine. In 1870 he built one which worked. His sun engine had a light frame lined with flat mirrors. The mirrors reflected the sun's heat against boilers and heated water to make steam. Unfortunately Ericsson's engine did not work so well as the inventor had hoped.

Many other inventors have tried to make the sun work for us. Some sun engines are actually working today in Egypt and in the United States. Although they do work, they do not give much power and they cost so much to build that they are not commonly used. The problem of getting power directly from the sun is one that still waits to be solved. But since scientists today are constantly searching for a way in which sun power can be harnessed, perhaps some day we shall have a successful sun engine.

Dr. C. G. Abbot, secretary of the Smithsonian Institution in Washington, D. C., has made a successful sun cooker. A large curved mirror reflects the sunshine upon a long pipe filled with oil. The hot oil goes through other pipes that heat two ovens. He is also the inventor of the sun engine shown in the picture below, which works in a similar way to heat the water in the boiler of a small steam engine.



Science Service

SOLAR ENGINE invented by Dr. C. G. Abbot (who is shown at the right). The heat reflected from the curved mirrors is used to make power.

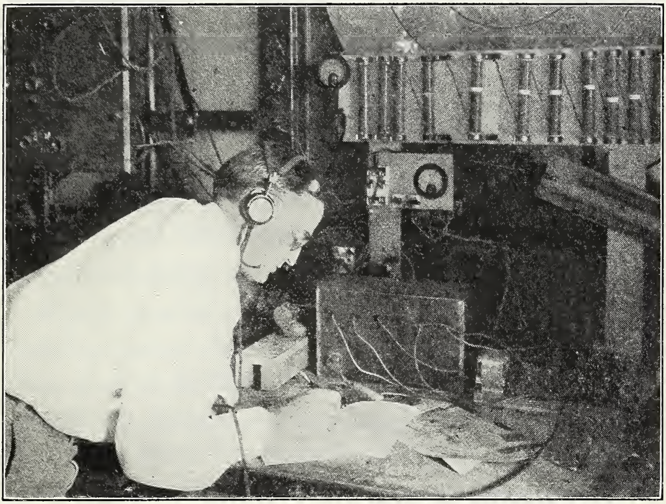
In the southwestern part of the United States, some people have built sun water heaters on the roofs of their houses. These heaters give the families plenty of hot water.

Because the control of power is so important to our ways of living, scientists are trying to find other ways of harnessing power than those you have learned. There are engineers who want to harness the tides. In the Bay of Fundy, in eastern Canada, the tide rises and falls from fifty to seventy feet twice a day. There are high tides also in eastern Maine. Engineers have suggested that dams could be built to catch the water at high tides and hold it back until the tides go down. Then the water could be released through water turbines and make electricity to use as power. But such power plants would be rather expensive.

Another interesting thing some men are trying to do is to harness the power of freezing water. When water freezes in a closed container, the ice that forms presses thirteen and one-half tons to every square inch. It is difficult for us to imagine an engine which could harness this enormous pressure, but perhaps some day one will be invented.

In chemical laboratories all over the world scientists are experimenting. They spend years patiently working with chemicals and instruments, large and small, hoping to find still other sources of power to work for man. In time probably all the coal and oil in the world will be used up and man will have to find other fuels to make his engines go. Men have already found a way to get more gasoline out of crude oil than we ever had before. They hope that this will make the world's supply of oil last much longer. In laboratories men are working to find ways to harness alcohol for power. Automobiles have been run by mixing alcohol with gasoline to furnish power. Perhaps, some day, this will be a common thing.

Because we can get steam power by heating water with coal, we say that the coal has a great deal of power "stored in it." Scientists believe that all rocks, metals, water, and gases have enormous amounts of power stored in them. They are trying to capture some of this great power by using electricity on some of these materials instead of burning them as we do with coal. Have you ever heard anyone say "blown to atoms"? In ordinary conversation this means



Courtesy General Electric Company

A MODERN SCIENTIST working in a laboratory. He is in charge of research for a company that manufactures many things used with electricity.

blown into very small pieces. All rocks, metals, liquids, and gases are made of particles much smaller than anything we can imagine. These small particles are made of still smaller particles called "atoms." The enormous power that the scientists are trying to capture is stored in the atoms. They have figured that a pound of any kind of atoms has stored in it eleven billion times as much power as we can get from a pound of gasoline. They are making experiments to see if they could get even a little of this great power, and some able scientists believe that they will succeed in the future.

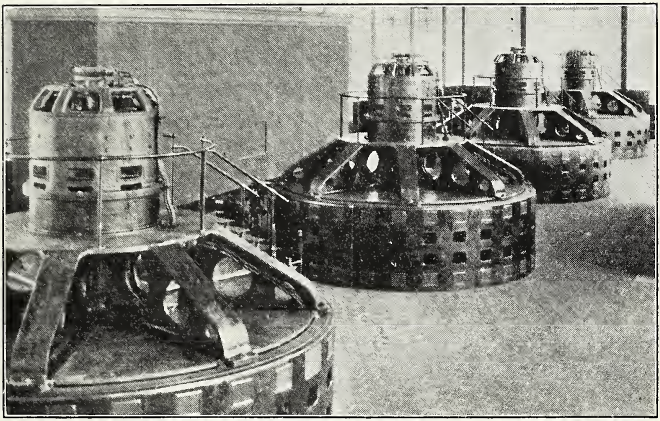
Although men have learned how to harness many of the powers of nature, they are not satisfied even yet. Scientists are constantly working in laboratories to discover new sources of power, and new ways of harnessing power. We hope that in time they will succeed in their search. During the past two hundred years men have done remarkable things in the harnessing of power. Who knows what lies in the future?

For Your Notebook

In your notebook paste any pictures of sun engines and sun cookers that you can find. If you find any other pictures that show how men are searching for new sources of power, be sure to paste them in your notebook.

14

Power in the Age of Machines



Ewing Galloway

DYNAMOS in a great power plant.

Power! POWER! POWER!

Man's muscles make it. The winds carry it. Water rushing toward the sea has it. Steam is alive with it. Coal and oil far inside the earth have stored it away. Electricity carries it silently and swiftly along miles of wire. The tides have it. And far in the sky the sun sends it to the earth day after day, year after year.

Power! And men have harnessed its force. With water wheels and windmills, and with steam engines, gasoline engines, and electric dynamos they have taken the power that nature has and made it work for them.

Because man has been so successful in harnessing power and inventing machinery, we live today in what is known as the "age of machines." Ways of living in this machine age are very different from what they have ever been before. It may be that they will change even more in years to come. The rest of the stories in this book will tell us some of the ways in which the use of machines and of power influences our ways of living.

A Power Frieze

From the pictures your class have drawn during this year make a "Power Frieze." You may have to draw some new pictures to complete the story of power.

A Power Exhibit

Gather all the models you have made into an exhibit showing the kinds of power about which you have learned in this unit.

A Pageant

Would you like to give a pageant showing the different kinds of power and how power is used to give us better ways of living?

Make a Speech

As if you were *Power,* make a speech telling what you have done for our ways of living.

Reading Time

It is hard for most of us to understand just how steam engines, gasoline engines, and electric dynamos and motors work, but we can all see about us how man has learned to make these things work for us. In the following list of books you can find stories that tell us how man has learned to make nature's powers work for him. Bring to class some of the library books that have good pictures. The class might enjoy the pictures in books written for older boys and girls, even though the reading is rather difficult.

Books that Tell the Story of Power:

Bachman, Frank P., *Great Inventors and Their Inventions.*

Bock, George E., *What Makes the Wheels Go 'Round.* (Contains excellent pictures.)

Coolidge, Anne, and Bona, Anthony di, *The Story of Steam.*

Edelstat, Vera, *A Steam Shovel for Me!*

Evans, Wainwright, *The Thunder Bird; The Story of Fire.*

Gibson, Charles R., *Romance of Modern Electricity.*

Haynes, Muriel, *Our Electric World.*

Hough, Walter R., *The Story of Fire.*

Jones, Wilfred, *How the Derrick Works.*

Lansing, Marion F., *Man's Long Climb.*

Petersham, Maud, and Petersham, Miska, *The Story Book of Coal; The Story Book of Oil.*

Talbot, F. A. A., *All about Treasures of the Earth.*

Tower, W. S., *The Story of Oil.*
Unit Study Books, No. 451: *Electricity and Magnets.*
Unit Study Books, No. 308: *The Story of Coal.*

Talking Time

In Forman's *Stories of Useful Inventions,* pages 54–72, in Bachman's *Great Inventors and Their Inventions,* pages 7–24, and in other books of inventions, you can find the story of the invention of the steam engine. Appoint someone to tell the story to the class.

On pages 164–173 of Carpenter's *The Houses We Live In,* there is the story of coal and a visit to a coal mine. Look in such books as Tappan's *Diggers in the Earth* and the Petershams' *The Story Book of Coal* for more information.

Look on pages 120–122 of Bush and Waddell's *How We Have Conquered Distance,* in the Petershams' *The Story Book of Oil,* and in the encyclopedias for more information to tell about oil and gasoline.

On pages 143–147 of Carpenter's *The Ways We Travel* and pages 122–123 of Bush and Waddell's *How We Have Conquered Distance* there are other stories of the invention of the gasoline engine. You can find more information in the encyclopedia.

What Makes the Wheels Go 'Round, by George E. Bock, is hard reading, but you will enjoy the pictures. Be sure to look at "Hydroelectric Power Plant," between pages 24 and 25, and "Steam Power Plant," between pages 44 and 45. The end papers show how much horsepower man was using one hundred years ago and how much he is using today.

UNIT V

COMMUNITIES IN THE AGE OF MACHINES

NO U TURN

1

What Bowling Green Has Seen

Near the tip of Manhattan Island in the city of New York is a little park called Bowling Green. This little green plot now surrounded by skyscrapers and busy wharves was once really a bowling green. If the little patch of grass could talk, it might tell us a fascinating story—the story of all the changes it has seen during the last three hundred years and more.

It may be that right at this spot, even before there was a Bowling Green, a Dutch governor, Peter Minuit (mĭn′ū-ĭt), bought the island of Manhattan from the Indians. Dutch people—from Holland, or the Netherlands—were wanting to make a settlement here only a few years after the English settled at Plymouth. Minuit gave the Indians about twenty-four dollars' worth of beads and trinkets for the island, which has an area of 14,000 acres. At the southern tip of the island the Dutch founded New Amsterdam, the chief village of their colony of New Netherland. Little did the Dutch settlers or the Indians realize that New Amsterdam would some day grow to be the largest city in the New World and the second largest in the world.

Credit: *California Toll Bridge Authority*

Many, many automobiles, as you know, are used in and near large cities. On the facing page you see part of the long bridge stretching east from San Francisco.

Governor Minuit's Offer for Manhattan Island

As soon as Manhattan Island had been purchased, a log fort was built, and the space opposite the entrance to the fort became the "Plaine," or Green. On the Green children played and danced, and the soldiers of the fort paraded. On it a well was dug for the little settlement, and to it the settlers came for their water supply. On Sundays, after more people came to live in New Netherland, the Green was crowded with country wagons which had brought the people to church. In the fall it was the scene of country fairs.

Early Dutch Houses in New Amsterdam

As the village of New Amsterdam grew, the "Plaine," or Green, saw neat little rows of houses being built in the neighborhood. In the houses the busy Dutch housewives and their daughters were working. They cooked, made soap, dipped candles, spun, wove, sewed, and did all the other things that had to be done in order to keep a family clothed and fed and as clean as a Dutch housewife would insist.

Outside the spotless little homes grew gay flower gardens and neat rows of vegetables. Farther up on the island farms were being started. Here men were at work, plowing, sowing, and reaping with the kinds of farming tools that their forefathers had been using in Europe for many centuries. The little Green heard the grating and crunching of the windmills of the neighborhood as they ground the wheat and corn that were brought to the mills. New Amsterdam early became famous for its flour, which was shipped in great quantities to Europe. The Green heard, too, the whir of the potter's wheel and the sound of the anvil as potters and blacksmiths set up their shops in the settlement. Farther up on the island, groups of settlers were founding Harlem and other little settlements. Far up the Hudson River was Fort Orange, where Albany now stands.

In 1664 the Green saw courageous, blustering, one-legged Peter Stuyvesant (stī′vĕ-sănt) surrender the Dutch fort to the English. The English took possession and then the name of New Amsterdam was changed to New York. Most of the Dutch colony of New Netherland became the English colony of New York. For fifty more years the Green saw the life of

Bowling Green in the days of long ago. What games do grown-up people play outdoors today?

some of the settlers and their descendants in the colony. Then, early in the 1700's, houses were built on part of the Green and a fence was put around the rest of it. The fence enclosed a bowling green on which the young men of the neighborhood played the popular game of "bowls," with large wooden balls much like those now used in tenpins. From this game the little park took the name of Bowling Green, which it has had ever since.

The days when people played bowls on the Green are now long past. And our story, too, must leave the days of Dutch and English playing on the Green, and get on with the things that Bowling Green has seen since 1700. During colonial times, it saw sailing vessels bring settlers and traders from England, France, Germany, and the other countries of Europe. It saw settlements growing in New Jersey, to the west of Manhattan, and on Long Island, to the east. It saw trade carried on between the port of New York and the other ports on the Atlantic coast, such as Boston, Philadelphia, and Charleston. It watched, too, shiploads of furs, timber, and grain setting sail for England to be exchanged for fine cloth, books, and many things made in the shops of England.

Even though Bowling Green heard changes in language and saw new people and many new houses around it, it saw very little change in the way work was done until after 1800. In all the years between the building of the Dutch fort on Manhattan Island and the inauguration of George Washington as President in 1789, Manhattan gained a population of only 33,000, and the whole region that today is the vast city of New York had less than 50,000 people. After 1800, however, things began to happen fast, and Bowling Green saw such changes as it could never have imagined would happen. Steam engines were beginning to do more work than winds and muscles could do. After 1800 people in America were beginning to make things in factories with the aid of machines driven by steam, instead of in the homes or in little shops with the aid of simple hand tools. Men were building many factories in New York and its neighborhood.

In 1807 Robert Fulton steamed up the Hudson

River in the noisy *Clermont*. As time went on, more and more ships driven by steam came into New York Harbor, docked to unload passengers and cargo, and then steamed away again. Ships became larger than anything little Bowling Green had ever thought possible.

After 1825 Bowling Green saw New York grow very rapidly. In that year something happened which soon made New York the most important seaport in America. In 1825 the Erie Canal was completed. The canal connected Buffalo on Lake Erie with Albany on the Hudson River. Grain and other farm products could come in canalboats from the fertile plains of the Middle West by way of the Great Lakes, the Erie Canal, and the Hudson River to New York. On the return trip to the West, the boats carried from New York goods made in the rapidly growing factories of the East.

Shortly after the opening of the Erie Canal men started another good way of carrying goods and passengers. They began to build many miles of railroad. With the canal and the railroads and steamboats giving New York such good transportation, it is no wonder that the port became busier and busier in the work of exchanging goods. The Green heard of more and more factories. Across the river and bay, in New Jersey, silk mills were started. Bowling Green heard that at last men were making steel quickly and cheaply in the mills of Pittsburgh, Bethlehem, and other towns of

Ewing Galloway

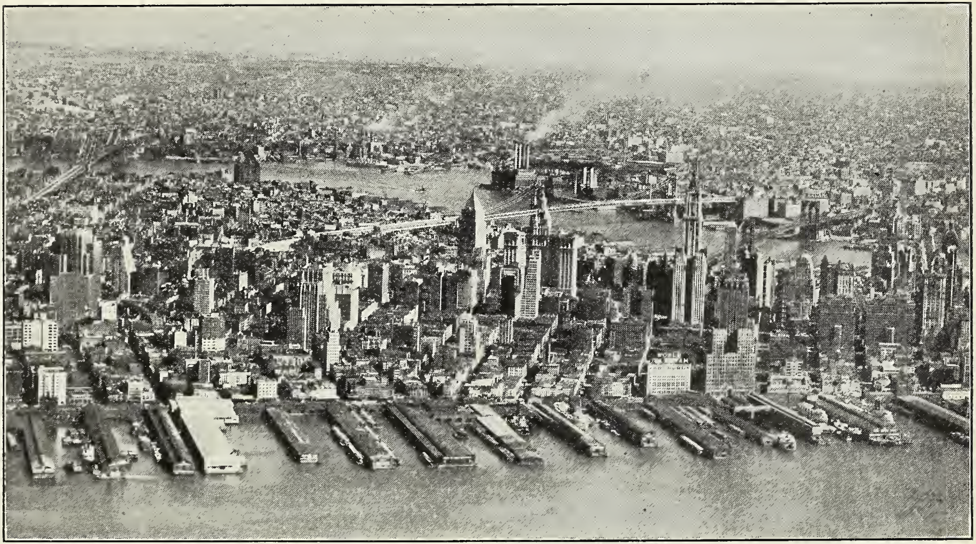
BROOKLYN BRIDGE, crossing the East River from Brooklyn to Manhattan. When built, in 1883, it was one of the largest in the world.

Pennsylvania. Soon the Green saw the strong metal being used in houses, bridges, and ships. To the east, in Brooklyn, which later became a part of New York City, workers were refining great quantities of sugar and roasting tons of coffee. To the west, in New Jersey, other men worked in great refineries which were busy day and night treating oil so that it could be used for many things.

You may be sure that Bowling Green had a good view of the millions of immigrants who came from Europe to work in the factories of our country, to help build our railroads, and to till our soil. Thousands of these immigrants made New York their new home. Many of the newcomers to the city from Europe and from the villages and farms of our own country were crowded into unsatisfactory buildings called *tenements*. Good air and light and sunshine were often missing from the tenements.

Quiet little Bowling Green, if it could think, must have been bewildered by the many changes it saw after the coming of steam engines and machines. Horsecars and gas lights were first used in New York in the 1820's and 1830's. A half century later a new source of power was beginning to drive motors and to light homes and streets. On Pearl Street, in New York City, Thomas Edison had established an electric power plant. Soon electrically driven streetcars and electric lights took the place of horsecars and gas lights.

In subways under the ground, high up in the air on elevated tracks, and on the streets, people were riding quickly and cheaply in cars driven by electricity. On the streets automobiles driven by gasoline were taking the place of the horses and wagons that the Green had seen every day since the early days of New Amsterdam. Today Bowling Green is accustomed to the underground rumble of the subway, the screeching of surface and elevated cars, and the honking of trucks and automobiles. Well paved roads, ferries, tunnels built under the Hudson River, and bridges make it possible for automobiles, trucks, busses, and trains to come in and out of the city quickly and easily.



Aerial Explorations, Inc.

A VIEW OF NEW YORK CITY, as seen from an airplane today.

In the foreground is part of Manhattan, and farther away, beyond the East River, is part of Brooklyn. Notice three bridges connecting them. The one at the right is the Brooklyn Bridge (page 376). Bowling Green is a tiny park at the tip of Manhattan, a little farther to the right.

Bowling Green no longer has a well. The water for the thousands of homes, stores, and factories of New York no longer comes from wells such as once served the settlers of New Amsterdam. Instead, hundreds of miles of pipes are buried under the streets of the city, and through these pipes water from great reservoirs is brought to the millions of homes and factories and offices. Some of the great reservoirs are on streams many miles north of the city.

No longer is Bowling Green bordered by the trim little Dutch houses of New Amsterdam or the stately mansions of the early 1800's. In their places stand tall office buildings made of steel frames covered with stone, brick, and cement. In many of the offices the work of securing money to build and run factories and to exchange goods is carried on, and New York has become the money center of the United States and of the world. Most New Yorkers are no longer living in single houses. They live in large houses divided into several homes, or in tall apartment buildings in which many, many families dwell under one roof.

Though no one now plays on the grass of Bowling Green, New York City has many parks, playgrounds, schoolyards, and gymnasiums where people come to play. Broadway, the street that has its beginning at Bowling Green, is now the longest street in the world, and part of it is the amusement center of America.

Bowling Green has seen a quaint little village grow into one of the largest cities the world has ever known.

It has seen the coming of the age of machines, and it has seen many ways in which machines have changed the ways of living of the people whose homes are in New York.

Talking Time

Imagine that a square or a green or an old monument or some other landmark in your community tells of the changes it has seen as the years have gone by. Write an account of what the landmark says and read it to the class.

Ask your parents, grandparents, or older residents of your community about the changes they have seen. The class should have some very interesting stories by the time you are through.

The Bulletin Board

Start collecting pictures which show what communities are like in the age of machines. Put these pictures on your Bulletin Board. Look in magazines and the picture sections of newspapers for pictures. Sometimes you can find good pictures in the advertisements of dynamos, busses, and many other things used in communities today. Arrange these pictures on one-half of your Bulletin Board. On the other half post pictures showing how communities looked before the age of machines.

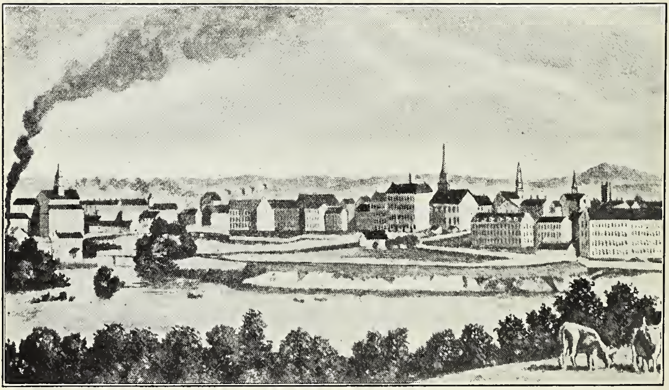
2

How Two Other Cities Grew

At the time when Bowling Green saw the *Clermont* steam up the Hudson River and heard men talk excitedly of the invention of new machines and the harnessing of new sources of power, there was a little village on the Merrimack River in the northeastern part of Massachusetts. The people of the village lived quietly, working on their farms and gardens, in their homes, and in their shops. They did not know that the age of machines was to change their village in the same ways it was already changing New York. The quiet village was to become the busy manufacturing city of Lowell (lō′ĕl), for many years the center of the cloth-making industry in the United States.

By this time Americans had learned from England how to make machines for spinning thread and weaving cloth. It was in the year 1822 that a group of men decided to build some factories for the new machines so that the spinning and weaving could be carried on in one place. The men were going to buy their cotton from Southern plantation owners, but they wanted to build their factories where there was a good source of power and where transportation to market was easy. They decided that the place they wanted was the banks of the Merrimack River. They bought land there, harnessed the water power, and soon had it turning many spindles and working great looms. In 1823 the first cloth came from their factories. The little village on the Merrimack had become Lowell, the "Spindle City," making cotton cloth for all the world to buy.

In 1800 there were only a few people living in the village. In 1826, three years after the factories had opened, two thousand people were living there. By 1836 there were 18,000 people, with carpenters building more and more houses all the time, and yet not enough houses to meet the need. More mills were built, and for many years Lowell made more cotton cloth than any other city in the United States. Its factories stretched for a mile along the river bank. Many rows of tenement houses were built. The new houses were not so roomy as the old village houses,

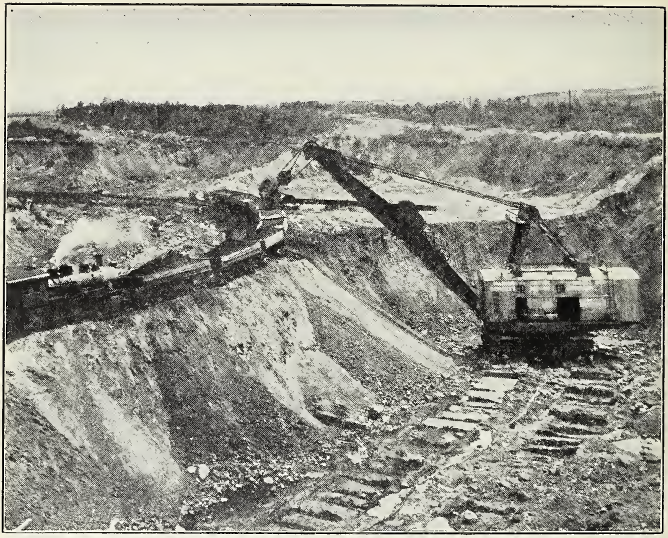


MILLS IN THE CITY OF LOWELL IN 1838. From an old print.

and the yards around them were not so large. Railroads were built to carry the cotton cloth to market and to bring food and supplies into the city. Sidewalks, paved streets, street lights, coal smoke, larger buildings, a water system—all these and more, as the years went by—made life in Lowell different from what it had been before. Lowell became a modern city, with comforts and with problems that were unknown in the days before factories. Think what changes the banks of the Merrimack River have seen! Their story would be as interesting as the story of Bowling Green.

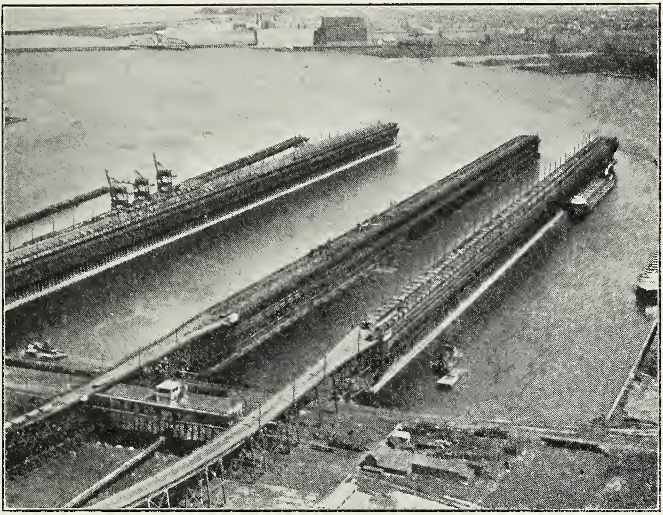
* * * *

The story of Gary (gâr'ĭ), Indiana, is another interesting example of how the age of machines has influenced the way people live in cities. When steel was first made in large amounts in the United States, most of it was made in the region around Pittsburgh, Pennsylvania. Both iron ore and coal for smelting the ore into iron and steel were found in the mountains of Pennsylvania. Later there was discovered in northern Minnesota, just west of the tip of Lake Superior, great hills of iron ore which could be easily dug from the ground. The iron ore in the Lake Superior region was the most valuable iron ore in the world. More and more the steel mills used it to make their iron and steel. It was shipped by boat through the Great Lakes to Cleveland, Ashtabula (ăsh-tȧ-bū'lȧ), and Erie and then taken by train to the steel mills at Youngstown, Homestead, and Pittsburgh.



AN IRON MINE IN MINNESOTA, from which ore is shipped to Gary, Indiana, and to other steel-making cities.

In 1905, however, the largest steel company in the United States decided to build new steel mills. Where should it build them? Many men studied for many weeks trying to select the best place. It cost a great deal of money to carry the iron ore from Minnesota to Pennsylvania. But if the factories were to be built in Minnesota where the iron ore is, it would cost a great deal to ship coal there and to send the iron and steel to market. Finally, the steel company decided to build its new mills at the southern end of Lake Michigan. There it would be able to get the coal



Great Northern Railway

Docks at Duluth. Trains bringing ore dump it into great bins; and from the bins it slides down chutes into ore ships.

from Illinois and Pennsylvania by railroad. The iron ore could be loaded on boats at Duluth (do͝o-lo͞oth′), Minnesota, and Superior, Wisconsin, and taken through Lake Superior, through the locks at Sault Ste. Marie (so͞o′ sȧnt mȧ-rē′), and through the Strait of Mackinac (măk′ĭ-nô) into Lake Michigan. Giant machinery could load thousands of tons of ore into a boat in a few hours. The boat could go from Duluth to the southern end of Lake Michigan in three days, and more giant machinery could be built to unload the ore from the boats and have it ready for the steel mills' use.

It did not matter to the men of the steel company that there was no town at the southern end of Lake Michigan. They would build a town! They bought thousands of acres of land, most of it sandy and swampy. They decided where to build their mills, and then built a great harbor and docks for the ore boats. They marked out the streets of a city, constructed a water system, paved the streets. They sold land on which were built houses and stores, schools, churches, and playgrounds and parks. In five years after the work was begun, 17,000 people were living in the new city which the age of machines had created. In 1930 the city was six times as big as it had been in 1910. One hundred fifty million dollars were invested in its factories and mills. Other factories were built there to be near the steel mills. By 1928 Gary, as the city was called, had 200 miles of streets and boulevards, 135 miles of water mains beneath the streets, 90 miles of streetcar tracks, 4 miles of bathing beaches, and over 500 acres of public parks and playgrounds.

The story that the sands on which Gary is built could tell of the coming of the age of machines would match the stories that Bowling Green and the banks of the Merrimack River could tell.

Why My City Grew

If you live in a city, find out what caused your city to grow from a village. Explain why the industries or factories you mention happened to start and to grow in your city. Remember such things as good transportation, a good supply of the things needed in the industries, and nearness to people who would buy the things made in the factories.

If you live in the country tell about the reasons for the growth of a large city near you.

A Counting Game

Look in the back of a geography for the list of cities in the United States. Look at the number of people, or population, in each city. Then answer these questions:

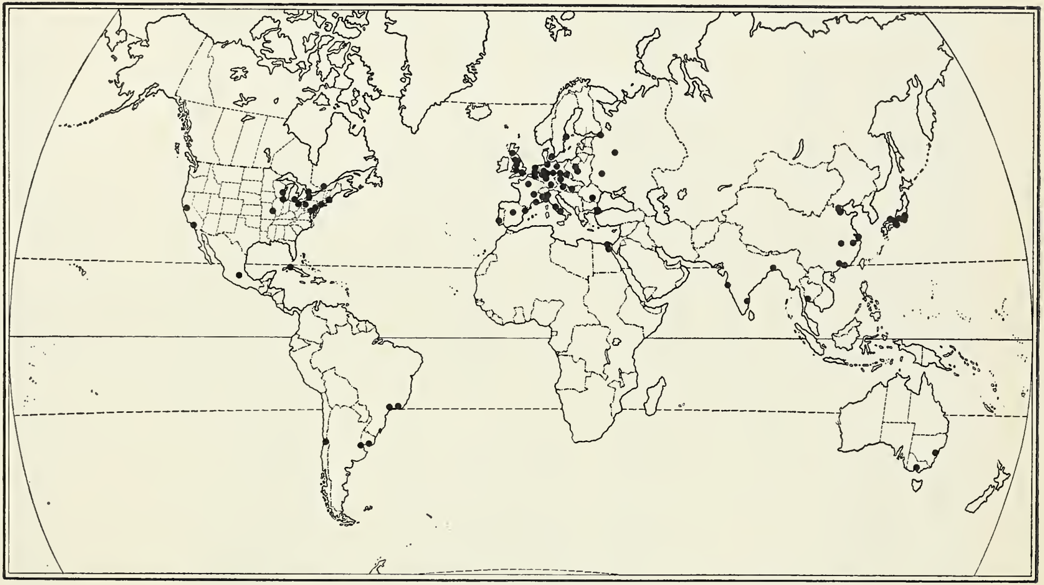
How many cities in our country have a population of 1,000,000 or more?

How many have a population of 500,000 or more?

How many have a population of 100,000 or more?

A Pageant

Give a pageant for your school assembly showing scenes from the history of your own community, or of New York or Lowell or Gary.



Location of Cities Having More Than 500,000 Population

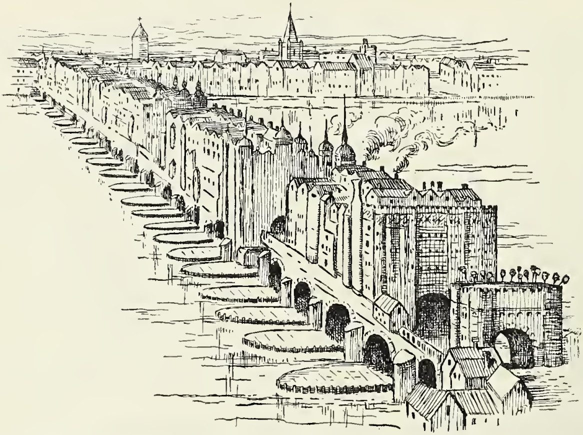
In what countries are these large cities located? You will find most of them, but not all, named in the maps on pages 18–19, 40, and 136–137, and in the stories on pages 389–410.

3

Foreign Cities in the Machine Age

For many, many hundreds of years in southern England a short, broad river has flowed eastward to the sea. In early times there was a shallow place where travelers on foot, beasts of burden, and cattle could wade across the stream about sixty miles above its mouth. Such a place where travelers cross a river is called a *ford.* In ancient England many paths came together at this ford from both sides of the river. As years passed the paths were widened and worn into roads. Because so many roads led to the ford, a great many people often met there to rest, to change their loads, to talk, and to trade. People often make settlements at such places. So here in southern England the ancient Britons made a little settlement. This settlement was the beginning of London, on the river Thames (tĕmz).

Many years afterward the people built a bridge over the river below the ford. When merchants of other countries sailed their ships to Britain, they loaded and unloaded them at the bridge. From all parts of Britain people brought goods to the ships. Settlements are sure to be made at places where people change from one way of traveling to another or from one way of carrying goods to another. The change here was from land to water and from water to land. This alone would have made the town of London grow. When Julius Caesar invaded Britain for the second time in 55 B.C. London was already important for its many merchants and its trade.



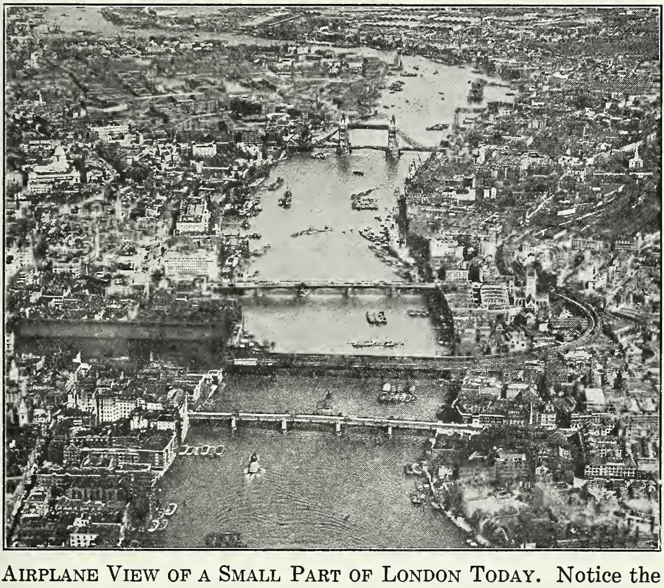
Here you see a very old picture of London Bridge, with many buildings on it.

Eight hundred years later King Alfred the Great made London the capital of his kingdom. London soon grew to be England's largest city. It was England's great gateway to all the rest of the world. As the British Empire grew, the ships of all nations came to London. London began to grow faster than most other cities and for many years it has been the world's largest city.

Just as Bowling Green saw many changes brought to New York by the age of machines, so the Thames

River saw new ways of living come to London. Railroads and automobile roads took the place of wagon roads. Travelers and goods that used to come and go in sailboats now come in greater numbers by steamboats. Trolley cars, automobile trucks, and busses speed along the streets where only coaches and carts were once drawn by horses. Subway trains roar through tunnels under the city, carrying thousands of people to their work and home again.

A city where so many shiploads of raw materials are collected, stored, and shipped away, would be sure to



AIRPLANE VIEW OF A SMALL PART OF LONDON TODAY. Notice the bridges, the boats, and the kinds of buildings.

manufacture many of these raw materials into goods or "finished products." Because hundreds of different kinds of materials are brought to London, hundreds of different products are made there. Some of the mills and factories there manufacture clothes, prepared foods, and shoes.

If you could have traveled from London to Dover in the year 1700, then across the Strait of Dover to Calais (kȧ-lĕ′) in France, and south to the Seine (sān) River, you would have found a city about as large as London. This city began when a tribe of early inhabitants built a village of mud huts on an island in the river not far from the place where the Marne (märn) flows into the Seine. The uncivilized tribesmen were called "Parisii" (pȧ-rĭz′ĭ-ī), and their village of mud huts grew to be the great city of Paris, the capital of France. From all directions paths and later roads led to this place, as did the two rivers.

Paris has grown to be the third largest city in Europe. While goods were made by hand tools, many workers came to Paris because of its central location. In the age of machines more people came to work in the factories which sprang up along the river, because it was both easy and cheap to bring coal to them by water. Today many railroads bring still more coal and raw materials to Paris to be made into goods. The chief products of the industries of Paris are women's clothes and hats. Other products are jewelry, artistic leather articles, embroideries, perfumes, scientific instruments, glassware, and ornamental goods. In recent years the machine age has brought to Paris the manufacture of automobiles, machines, and tools.

Another great city in Europe which, like Paris, grew because of its central location, is Berlin (bûr-lĭn′), the capital of Germany, on the river Spree (shprā). Canals join the Spree with other rivers which flow to the Baltic (bôl′tĭk) and North seas. Railroads connect Berlin with many other European cities, and today air lines reach far and wide in every direction. Because heavy raw materials and coal can be brought in easily by water, Berlin has become a large manufacturing city. The factories there make machinery, cloth and clothing, electrical machines and goods, shoes, dyes, chemicals, and glassware. The machine age has given new ways of working, new ways of traveling, and other new ways of living to the people of Berlin.

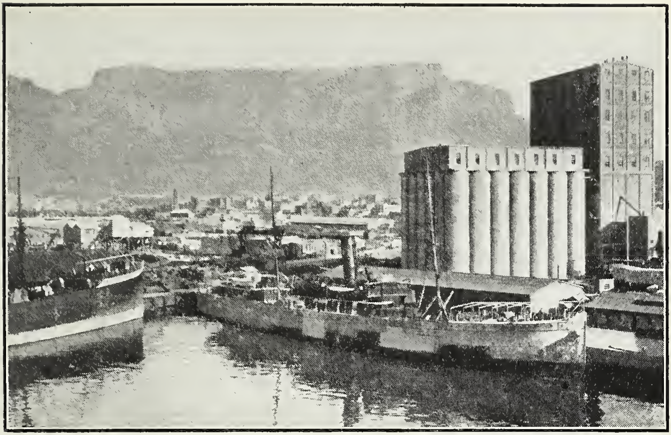
Germany has several large seaport cities. The largest of them is Hamburg, on a river that flows into the North Sea. Other important seaports that are reached by ships from the North Sea are Amsterdam and Rotterdam in the Netherlands, and Antwerp in Belgium. This location has made them important cities for trade, shipbuilding, and many kinds of manufacturing.

The valley of the Danube River runs east and west in northern Austria, and at one place a strip of lowlands extends from it north through Czechoslovakia. Here two paths of travel meet, and here the city of Vienna grew. Vienna is the capital of Austria. As a river city, it has shipping, mills, and factories. It is also a great railroad center with direct connections to many different countries in Europe.

A great inland city, fourth in size among the cities of Europe, is Moscow (mŏs′kō), the capital and the largest city in Russia, or the Union of Soviet Socialist Republics. Moscow probably began as a settlement where a forest gave protection from roving enemies and robber bands. It has a central location in a vast wooded and fertile plain. To old Moscow skilled workmen came from all parts of Russia and even from other countries to make useful and beautiful goods by hand. When the machine age brought railroads to Russia, they made Moscow a great railroad center. Coal, iron, and raw materials rolled into the city on the steel rails. Today the factories in Moscow make so many goods that the materials for them have to be brought in from other countries. Thousands of workers manufacture machines and tools, shoes, and goods made of cotton, wool, linen, and leather.

* * * *

Now we must cross the Mediterranean Sea and see the principal cities of Africa. Alexandria, on the Egyptian coast, developed as near the mouth of the Nile as ships could find a harbor. Cairo (kī′rō), the largest city in Africa, is located on the Nile River just where the broad delta of the river begins. Near the Cape of Good Hope is the city of Capetown. A good



South African Railways and Harbours

A small part of CAPETOWN, in South Africa. Notice the storage houses and the boats, which help to make the city's ways of living.

harbor, and its location near the southern point of the continent, have made it a stopping place for ships sailing between Europe and Australia. Such a seaport on the route of long voyages is known as a *port of call.* While you are looking at the map of Africa, notice that Léopoldville (lē′ō-pōld-vĭl) is the "gateway" of the Congo Basin region.

The machine age has helped the seaports of Africa to grow by bringing steamships to them and by giving them machines for loading and unloading raw materials and farm products. Modern mining machinery also has helped some cities to grow near the great diamond and gold mines in South Africa,—for example, Kimberley (kĭm′bĕr-lĭ), Pretoria (prė-tō′rĭ-*ȧ*), and

Johannesburg (yȯ-hän′ĕs-bûrg). Today Africa has no large manufacturing cities like those in our country and in Europe. In years to come, however, iron and steel products will probably be made in South Africa because there is much iron and coal there.

* * * *

Most of the large cities of Asia are seaports. In India near the delta of the Ganges (găn′jēz) River is Calcutta (kăl-kŭt′ȧ); on the west coast is Bombay (bŏm-bā′), and on the east coast is Madras (mȧ-dräs′). The capital of India is Delhi (dĕl′ĭ), an inland city. In recent years railroads, factories, and machines have come to these old cities. Calcutta has large mills and factories for making burlap for bags, and rope from the fibers of the jute plant. There are cotton mills in Bombay, Madras, and Delhi, and sugar and flour mills also have been built there. In these cities the age of machines has just begun, and many native workers still make goods in small shops and in their homes with hand tools. Old and new ways of manufacturing go on at the same time. We may learn a great deal about the way the age of machines affects communities by studying the changes that are taking place in the cities of Asia today.

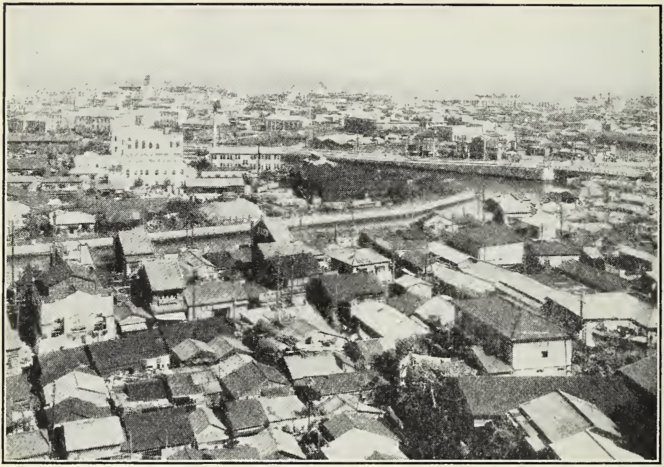
The cities of China also show us this same contrast between the old and the new, where the age of machines is beginning to change the seaports and a few inland places. Canton and Tientsin (tĭn′tsĭn′) have cotton mills. Shanghai (shăng-hī′) has factories for making

Society for Visual Education

Water Front of Shanghai, in China. Important parts of this city are occupied by white men from Europe. In such cities as this the East and West meet, and the "age of machines" is beginning to make many changes.

cotton and silk goods, flour mills, and shipbuilding plants. About 400 miles west of Shanghai are Hankow (hȧn′kō′) and other near-by cities, making a little region of factories and mills where cotton and silk goods and iron and steel are manufactured.

Off the coast of China is the island Empire of Japan. Here also the old and the new ways of making goods go on side by side. Tokyo (tō′kyō), Yokohama, and Osaka (ō′zä-kä) have large silk and cotton mills. Osaka is called the "Pittsburgh of Japan," because it has blast furnaces for making steel, and factories where all kinds of iron and steel goods are manufactured.



Ewing Galloway

AIRPLANE VIEW OF PART OF YOKOHAMA. In the foreground you see houses where people live. In the distance is a new business district.

Even locomotives and ships are made there. Yokohama is the chief port of Japan.

* * * *

The island continent of Australia is small compared with the other continents, but the location and growth of its cities tell the same story of trading centers and the coming of the age of machines. The largest city in Australia is Sydney, which has its own shipyards and flour mills. Melbourne (mĕl′bẽrn), the next largest city, manufactures locomotives and mining and farming machinery. Still more modern industries will probably come to Australia as the population grows larger and larger.

* * * *

Pan-American Airways Photo

Airplane View of Rio de Janeiro, as seen from a great height. Beyond the city is its fine harbor. Notice the many mountains near the city.

In South America the great inland regions are devoted to farming and grazing. From the Andes Mountains ores and minerals are mined. Most of the cities are along the seacoast. The five largest cities are Buenos Aires, the capital of Argentina; Rio de Janeiro (rē'ō dā zhȧ-nā'rō), the capital of Brazil; São Paulo (soun-pou'lo͞o) in Brazil; Santiago (sän-tē̇-ä'gō), the capital of Chile; and Lima (lē'mä), the capital of Peru. All these cities have mills and factories for making cloth and clothing, shoes and other leather goods. There are hat factories in Rio de Janeiro and São Paulo, and there are flour mills in Santiago and Buenos Aires.

* * * *

If you should travel north from South America into Central America you would not find mills and factories there. The new ways of making goods by machines have not yet come to many places in Central America. Farther north in Mexico a beginning has been made. Factories and mills for cloth, leather, shoes, and flour have come to the city of Mexico and to some smaller cities. North of our country, in Canada, the two largest cities are Montreal and Toronto, which are important centers of manufacture and trade.

When you see pictures of cities in books, or their names on maps, you should remember that there was a time when the largest cities were only little clusters of small dwellings and shops. There is a reason why every town and city started where it did, and there are other reasons why every large place grew. Some of these reasons are the location of the city and the changes brought by the age of machines. The story of each city is told by its place on the map and by the flat or hilly land near by, the crops that grow, the animals that graze, and the ores and minerals in the rocks. Harbors, rivers, waterfalls, and lakes tell part of the story. Then the last part of the story of each large city is told by the progress and the wonders of the age of steel, steam, electricity, and machinery.

For Your Notebook

Can you find pictures of cities showing how they looked in the past and how they look today? Paste the pictures in your notebook. Be able to explain the differences between cities of older times and of today.

A Class Report

It has been said that the ten cities most important for American pupils to know about are New York, London, Washington, Chicago, Philadelphia, Boston, Paris, Berlin, Constantinople, and Rome. What can you find out about these cities to tell the class?

Talking Time

What do the names of these towns and cities tell you about the reasons for locating the settlements where they are:

Three Rivers
Harpers Ferry
Granite City
Sulphur Springs
Ironton
Copper City
Millville
Springfield
Iron Mountain

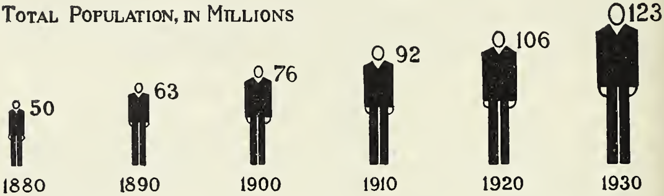
Planning a Trip

Each member of the class should select some city of the world, outside the United States, he would like to visit. He should tell the class how to travel from home to the city, and then describe the things in the city most worth seeing.

4

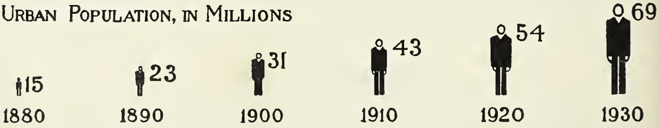
American Cities in the Machine Age

TOTAL POPULATION, IN MILLIONS



This row of men tells a very interesting story. It tells how steadily the population of the United States grew from about 50,000,000 in 1880 to nearly 123,000,000 in 1930. In every year, the number of births was greater than the number of deaths. During these fifty years, also, many people came from all of the countries of Europe, from Mexico and Canada, and from Asia to live in the United States. Many of them came to live on our farms, but many more came to work in our mines, in our factories, and on our railroads.

URBAN POPULATION, IN MILLIONS



This row of men tells another interesting story about the population of the United States between 1880 and 1930. In 1880 more of the people of the United

States lived on farms than in towns and cities. The number of people in the rural or country sections steadily grew larger, but the number living in the cities grew even faster. By 1920 more than half of the people of the United States lived in urban communities, that is, in cities or towns having more than 2500 inhabitants. And the size of the urban population has grown greater and greater since then.

The table below gives you an idea of how the sixteen largest cities in the United States grew. In 1830 most of them were either small cities or towns, or were not yet settled. By 1880 all of them were growing fast, and some of the new cities had become quite large. But notice how much larger they all were by 1930!

POPULATION GROWTH OF SIXTEEN CITIES

City	1830	1880	1930
1. New York, N. Y.	242,278	1,911,698	6,930,446
2. Chicago, Ill.	....	503,185	3,376,438
3. Philadelphia, Pa.	80,462	847,170	1,950,961
4. Detroit, Mich.	2,222	116,340	1,568,662
5. Los Angeles, Calif.	....	11,183	1,238,048
6. Cleveland, Ohio	1,076	160,146	900,429
7. St. Louis, Mo.	....	350,518	821,960
8. Baltimore, Md.	80,620	332,313	804,874
9. Boston, Mass.	61,392	362,839	781,188
10. Pittsburgh, Pa.	15,369	235,071	669,817
11. San Francisco, Calif.	....	233,959	634,394
12. Buffalo, N. Y.	8,668	155,134	573,076
13. Milwaukee, Wis.	....	115,587	572,249
14. Washington, D. C.	18,826	147,293	486,869
15. Minneapolis, Minn.	....	46,887	464,356
16. New Orleans, La.	46,082	216,090	458,762

You have already read something about many of these cities. What do you remember about New York (pages 372–380)? What about San Francisco? Do you remember in what state each of the sixteen largest cities is located? Let us now see why there was so great a growth in city population.

In the years between 1830 and 1880 more and more goods were being manufactured in the United States. But after 1880 there was a great increase in the old industries, and many new industries, such as the building of automobiles, began. Then many new factories were built and many more workers were needed. In these busy years factories grew up in towns and cities all over the United States. But there are five industrial regions where we find most of the factories and the largest number of people and big cities.

The first industrial region runs from northeastern Massachusetts to northern Delaware. Here we find the people living closer together than in any other part of the United States. If you were to travel from Boston to Baltimore, your train would for much of the time be going in and out of large cities and towns. There would seldom be a moment along your way when you could not see the chimneys of factories. Across what states would you be going?

The second region is along the Great Lakes from Buffalo to Chicago. On the eastern end of this section we find a great iron and steel and shipping center. The central part is a great automobile and milling center.

And on the western end we find Chicago, the chief center of the meat-packing industry of the United States.

The Ohio Valley from Pittsburgh to Louisville, Kentucky, is the third large industrial region. Boats going down the Ohio River carry many tons of iron and steel from the mills of Pittsburgh to the factories of Cincinnati and Louisville and the other large manufacturing cities and towns of that region.

Northern Alabama and parts of Georgia and North and South Carolina make the fourth industrial region. Steel and lumber and textile mills are springing up in many places in these states.

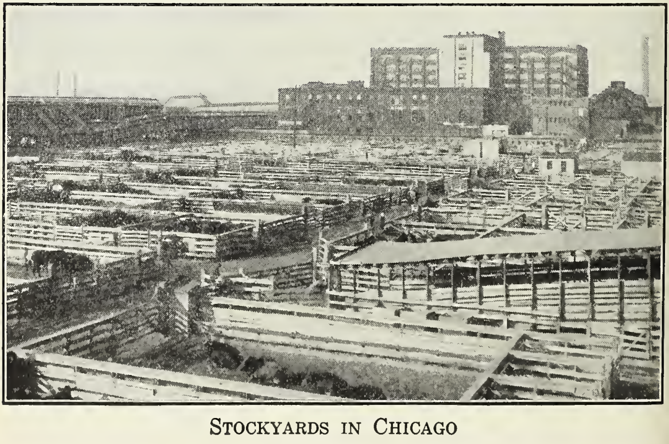
The large cities along the western coast of the United States from Seattle (sė-ăt′′l), Washington, to Los Angeles, California, make the fifth industrial region.

In all of these regions we find some very large cities, and some medium-sized, and many small cities and towns. Very nearly all of them owe their size to the coming of factories.

About the year 1822 a lumber mill was built on the Mississippi River at the Falls of St. Anthony in Minnesota. Around the mill a group of workers settled. Later the great plains around the falls were planted with wheat. Then flour mills were started at the falls, and many more people came to work in the flour mills. The little village grew into a town and then into a large city, which we know as Minneapolis. Today it is the greatest milling center of the world.

Underwood & Underwood

A Busy Street in Chicago

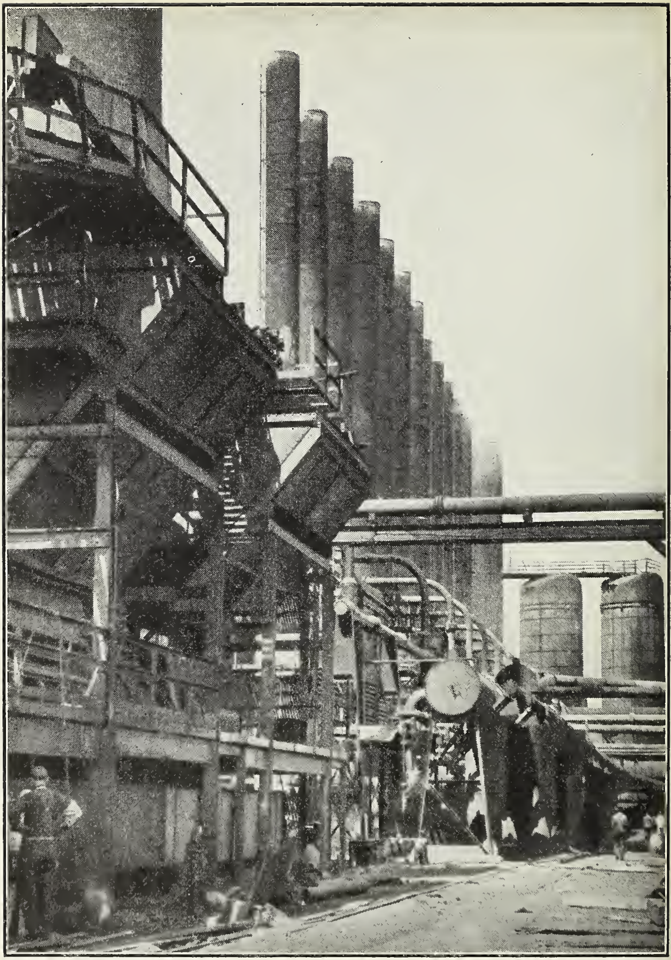


Stockyards in Chicago

Cyrus McCormick decided to manufacture his reapers in the small city of Chicago about the year 1850. People thought he was foolish to choose so small a city instead of one of the old manufacturing cities of the East. But McCormick thought that some day Chicago would be the center of a very large farming region where his reapers would be used. How much easier and cheaper it would be to send reapers to the farms from Chicago than from the factories in the East! McCormick was right. Today, Chicago is the largest meat-packing city in the world and the world's largest grain market. Besides farm machinery, the factories of Chicago make many other things.

The invention of the steamboat made the city of St. Louis, Missouri, grow from a small town to one of the largest cities of the United States. When goods could be sent cheaply and easily by steam up and down the Mississippi, the city of St. Louis built more and more docks along the river front. Soon it became the market for much raw material. Because manufacturers could buy raw materials so easily there, many of them built factories in St. Louis. Today, St. Louis has a population of over 800,000 people.

When iron and coal were found in the mountains around Pittsburgh and when iron ore could be shipped easily by boat from Lake Superior, great iron and steel mills were built in the city. Today Pittsburgh is called the Steel City because it is the chief center of the steel industry of the United States.



Ewing Galloway

Part of a Steel Mill near Birmingham. Large iron- and steel-making plants are important also in the growth of Pittsburgh, Gary, and many other cities.

Birmingham, Alabama, is another city which is earning the name of Steel City. Because men found iron ore in the mountains near Birmingham, mills were started and the city began to grow. Today Birmingham is the chief industrial city of the South.

You may think of many reasons which have helped Detroit to grow to be the fourth largest city of the United States, but one of the most important reasons is the manufacture of automobiles there.

It was the manufacture of rubber tires and other rubber goods which made the little town of Akron, Ohio, grow into a large city of over 250,000 people.

Four things made the city of Los Angeles grow. First of all, when railroads were built to Los Angeles, it became an important shipping center. Then in 1894 oil was discovered near the city. Later the city developed a very good harbor. Now it has many industries from rubber goods and iron and steel to the largest motion-picture industry in the world.

Before 1850, Kansas City, Missouri, was just an outfitting post for the pioneers going west along the Santa Fe (fā) and Oregon trails. But today it is a great industrial center. Highways going in all directions across the Central Plain meet in Kansas City. Today it is the market place and the meat-packing center for large farm regions of Kansas and Missouri.

New Orleans grew because of its location. Because it is so close to the mouth of the Mississippi River it is the center of trade for most of the Gulf States.

New Orleans, as seen from an airplane.

The river front in New Orleans is lined with wharves, cotton warehouses, grain elevators, steel sheds, and storehouses for many other products which come to the city to be exchanged.

Story after story can be told of the growth of cities in the United States. The reason for this growth can be told in three words—*the machine age.*

A Class Report

Find out how your own community was settled and how the ways of living in it have been changed by the age of machines.

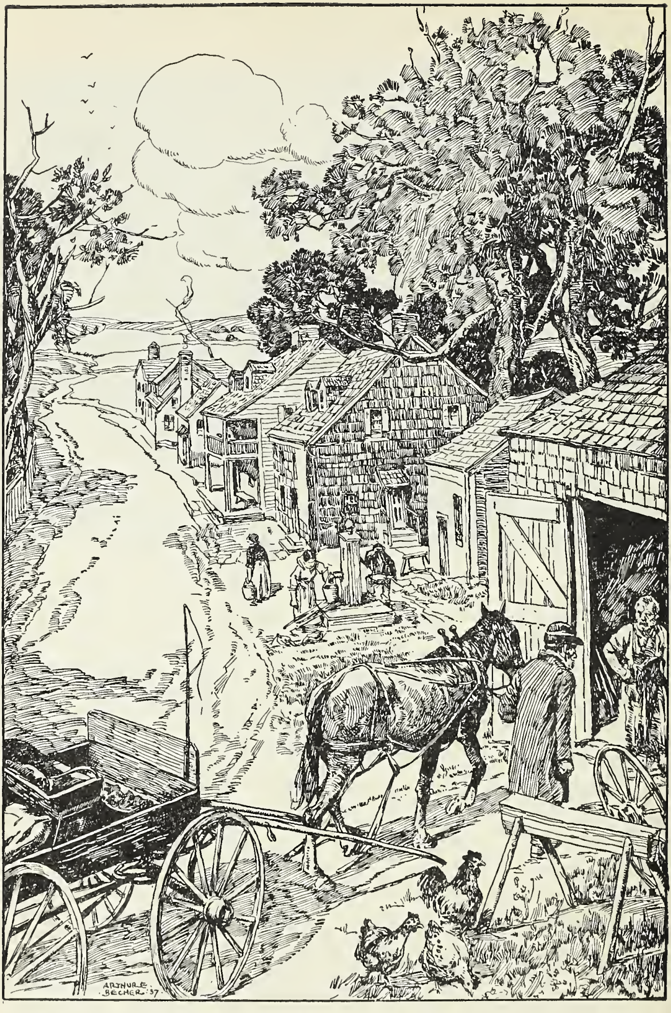
5

Grandfather Jenkins's Boyhood Home

"How things have changed!" exclaimed Grandfather Jenkins again and again to himself as he walked through the village near which he had lived as a boy. Fifty years had passed since he had moved away, and in all that time he had not been back to the old farm. He had looked forward eagerly to visiting the village of his childhood days, but so many things had changed that it did not seem at all like the same place.

The small village had grown into a larger one. The old covered bridge made of heavy timbers had disappeared, and a new concrete bridge spanned the river. The wooden water wheel that used to run the mill on the farther side of the bridge was gone, too. Now, a much larger mill was run by a steam engine. The general store where the farmers and the people of the village could buy everything from crackers to nails was no longer standing. In its place there was a row of several stores. One was a drugstore, another was a grocery and meat shop, the third was a drygoods store, while the last one sold hardware. There was even a bus station in the town, from which busses made regular trips to the nearest city.

The streets had changed, too. Instead of muddy roads, there were smooth concrete roads. Grandfather



This shows the village street as it looked when Grandfather Jenkins was a boy.

Jenkins could remember when the roads were so bad that wagons sank to the very hub in the mud, right in the center of the village, too. But such roads would not be very good for the many automobiles and trucks which drove through town that day!

As Grandfather Jenkins stood looking at the automobiles and the well-paved streets, he thought of the Holcolm family who ran the harness shop around the corner. He decided to visit them. But when he reached the place where the harness shop had been, he could not find it. In its place there was a garage and an agency for farm machinery. Even the name on the sign was changed. When he inquired about the Holcolms and the harness shop, he learned that the shop had not been run for years. When factories began to make harness cheaper than the Holcolms could make it, they had to close their shop. Then the Holcolm family had moved to a near-by city where the sons got work in a shoe factory.

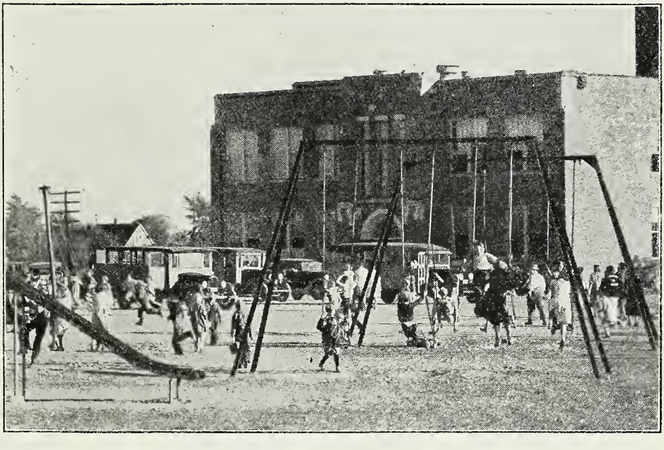
When Grandfather Jenkins was a boy, the farmers had only a few hand tools to help them. Now right in the very spot where the harness shop had been there was a store which sold all kinds of farm machinery. There were cream separators, potato planters, potato diggers, drills for planting grain, corn planters, steel mowing machines, and good steel plows. Farmers could order tractors there, too, and threshing machines run by gasoline engines, and harvesters that cut and bind the grain at the same time.

The same kind of surprises were waiting for Grandfather Jenkins when he drove out to the farm where he had lived. On his way to the farm he passed a fine brick schoolhouse. The old district school that Mr. Jenkins had attended had stood there once. It had been a little frame building with only one room, which was heated in winter by a big wood stove. Forty children of all ages crowded into the little district school to be taught by only one teacher. But the new school building had six light, airy rooms. It was heated by a modern heating and ventilating system. It contained a big auditorium, a gymnasium, and a library, too. Over two hundred children attended this school, and those who had to come a long distance were brought in the school bus.

As he came to the old farm, Mr. Jenkins could see that the people who owned it now had made many changes. The barns were new, the old well sweep was gone, and a concrete drive led up to a garage that was attached to the house. It was easy to see that the farmer now did not have to go out in all kinds of weather to pump water or to harness the team to drive to the village!

Inside the house there were many comforts and conveniences that Mr. Jenkins had not enjoyed when he was a boy. There were electric lights and a furnace and a bathroom. There were a telephone and a radio, and even an oil burner in the kitchen range! Mr. Jenkins could remember well the great armfuls of wood

A ONE-ROOM SCHOOLHOUSE, of the kind still seen in many country districts.



A SCHOOLHOUSE OF SEVERAL ROOMS, more recently built. Have you a picture of your schoolhouse?

he had chopped for the kitchen range when he was a boy, and the buckets of coal he carried in for the Franklin stove in the parlor! He could remember, too, how his sisters always had to clean the lamp chimneys and fill the lamps with oil. Studying around the little oil lamps was very different from reading by an electric light!

Mr. Simons, the man who owned the farm now, was a dairy farmer, so the most important building he had was the cow barn. On the first floor there was stable room for thirty cows. The floor was made of cement which could be kept clean easily. There were a great many windows and ventilators so that the air could be kept fresh. The milk room and the feed room were on the first floor, too, and were very clean. On the second

Modern Dairy Barn and other buildings, on a farm in Minnesota.

floor there were a large storage room and a tool room. Another room contained a feed mill and a feed cutter and a motor to run these machines. Attached to the barn were three large silos. In the fall the silos were filled with chopped cornstalks to feed the cows during the winter.

When Mr. Jenkins had seen the barn, Mr. Simons showed him the garden, the pasture land, and the cornfields, separated from one another by strong wire fences. Mr. Simons said that farmers can buy wire fencing cheaply today and do not have to spend their time and strength building old-fashioned stone walls or rail fences.

The time flew by very fast, and soon Mr. Jenkins had to go back to the village. When he was shaking hands for the last time with Mr. Simons, Mr. Jenkins said, "I wanted to see the farm and village where I lived when I was a boy. But there have been so many changes in the last fifty years that I don't feel at home at all."

"You're not sorry, are you?" asked Mr. Simons.

"No, indeed," answered Mr. Jenkins. "I am glad the rural communities are helped by all the new inventions and scientific discoveries that are made. I'm pleased with all the changes I find here, for they make the life of the farmer more comfortable. I realize now that the age of machines has changed ways of living on many farms and in small towns as much as it has changed them in the cities."

Then and Now

Imagine that you of today and a boy living on a farm seventy-five years ago meet and talk about farming then and now. Make a copy of the chart below in your notebook, but have much more space in the columns *Then* and *Now*. Fill out your chart by writing what each of you says about your ways of living.

Things done on the farm	*Then*	*Now*
How we take care of animals		
Our roads		
How we travel to school		
How we learn news of the world		
Our amusements		
How our grain is ground		
How we divide our fields		

An Explanation

Write one sentence to explain why the changes between "Then" and "Now" have happened.

6

Communities in the Age of Machines

The "age of machines" has changed the communities in which we live. There are more cities and larger cities now than there were long ago. More people live in towns and cities today. Cities and towns are different from what they were.

Think of what Bowling Green has seen! Think of the story that Lowell, or Detroit, or Chicago might tell you. Think, too, of the story of London, or of some other foreign city. What stories could the oldest building in your town or city tell about the changes brought by the "age of machines"?

Changes have taken place in farm life and village life, too. No matter in what kind of community we live, the "age of machines" affects our ways of living.

A Testing Game

Which word, or group of words, within the parentheses makes each of the numbered sentences true?

In your notebook or on a sheet of paper write the numbers 1 to 14, and after each number write the word or word group that you choose.

1. The largest city in the United States is (New York, Chicago, Kansas City).

2. The chief reason why London was founded was (manufacturing, trade, farming).

3. The age of machines usually makes cities (larger, smaller, about the same size).

4. New York City has many (farms, factories, castles).

5. Berlin is the capital of (France, Poland, Germany).

6. Lowell is a city in (Pennsylvania, Illinois, Massachusetts).

7. The chief thing made in the factories of Gary is (flour, cloth, steel).

8. Capetown is located in (South America, South Africa, India).

9. The Erie Canal is between Albany and (Boston, New York City, Buffalo).

10. Iron ore is brought to Gary by (train, boat, truck).

11. New York City was first settled by the (English, Dutch, French).

12. In the United States today there are (three, five, seven) great industrial regions.

13. During the last fifty years rural life in the United States has (not changed at all, changed only a little, changed a great deal).

14. In the United States there are (four, five, six) cities having more than a million inhabitants.

Reading Time

While reading about cities in the age of machines, keep your eyes open for newspaper and magazine stories and pictures that show what city life is like today. Here are a few books that tell about New York City and some of the other cities of our country. See what other books you can find. Bring to class books about your own city.

Books about the Growth of Cities:

Bond, A. Russell, *With Men Who Do Things.* (Stories of engineering feats in New York City.)

Evans, Ernestine, *The Story of the Harbor.*

Hotchkiss, Caroline W., *Representative Cities of the United States.*

Johnson, William H., *Chicago.*

Lenski, Lois, *The Wonder City.* (A picture book of New York.)

Mitchell, Lucy Sprague, and Lambert, Clara, *Manhattan, Now and Long Ago.*

Rugg, Harold O., and Krueger, Louise, *Communities of Men.*

Southworth, G. V., and Kramer, S. E., *Great Cities of the United States.*

Unit Study Books, No. 509: *Growth of Cities.*

Talking Time

In Rugg and Krueger, *Communities of Men,* you can find stories to tell about the beginning and growth of many communities in our country. Look up these stories in the book: "How Communities Begin," pages 325–343; "New York," pages 210–226; "New Orleans," pages 227–243; "Santa Fe and El Paso," pages 244–271; "San Francisco," pages 273–290; "Pittsburgh," pages 291–306; "Chicago," pages 307–322.

7

Turning on the Street Lights

One winter evening Tom and Dick were walking home from basketball practice. The sky was gray, and it was just dusk; soon it would be dark. Tom could hardly see the hands on his watch when he took it out to look at the time. As he bent his head to look closer, suddenly, without a sound, lights began to glow along

Wide World

NIGHT VIEW OF A CITY. This picture shows the light from many, many windows, and the brighter glow from the street lights on several streets.

the street. They seemed to drive away the dark, making it easy to see. Tom could read the figures on his watch now. Someone had turned on the street lights.

Have you ever driven in an automobile in the country and seen the lights of a city reflected in the sky many miles before you came to the edge of the city? From an airplane, city streets at night look like long rows of lights. The lights are close together in the business part of a city, and farther apart on the streets in front of people's houses.

The lights of a city are fascinating things. In olden times cities were not lighted after dark. In ancient Rome there were sometimes bonfires on the streets, or signal lights burning on high hills. But most of the streets were dark and dangerous after nightfall. Men and women did not leave their homes at night unless it was necessary. People who had to be on the streets after dark carried torches or lanterns with them.

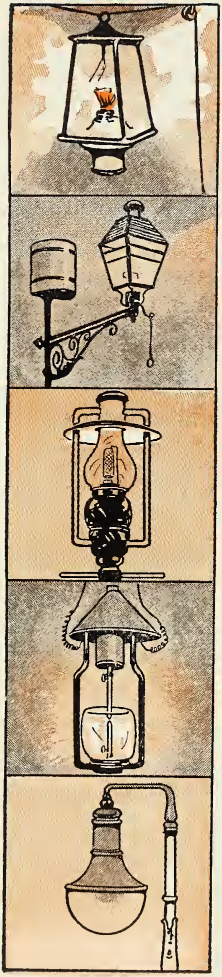
In the year 1415 the Lord Mayor of London ordered all citizens to hang lanterns in front of their doorways each winter evening. Watchmen went about the streets to see that the order was obeyed. It was not until the year 1736, only about two hundred years ago, that the city government of London took over the job of lighting the city's streets.

Of course there could not be good street lighting until men discovered how to make good lights. Primitive people used torches when they needed light in the darkness. Then someone found that grease or wax burns, and that a cloth put in a dish of oil will burn with a flame that is useful for lighting indoors. The next step was the making of candles. For many centuries people used candles. Even when George Washington was elected President, candles were the most common means of lighting. If you should visit Washington's home, the Mount Vernon plantation in Virginia, you would see two big glass chimneys which were put around the candles, when Washington lived there, to keep the candles from blowing out easily. In the year 1784, however, a Swiss inventor made a lamp which burned whale oil and which had a wick and a glass chimney. It gave a good, clear flame. People were greatly excited about it. Then, after kerosene was made from crude oil, as we know, kerosene lamps were used all over Europe and the United States. In many country homes in the United States today, kerosene is still used for lighting.

Soon after 1800 it was discovered that certain gases which come out of the earth give a bright flame when they are burned. Inventions came quickly. Before long people began to use the natural gas for heating and lighting. Soon many cities had miles of gas pipes running underground from house to house. In 1885 an inventor named Carl A. Welsbach (vĕls′bäκ) made a covering or "mantle" which made the light of a gas flame much stronger and steadier. Before many years had passed, the streets, as well as the homes, of some American cities were lighted by the new "gas lamps." Each night at dusk a lamplighter with a long pole would go around from lamp to lamp, turning on the gas and lighting the lamps one by one. Gas lights were a great improvement over oil lamps, but even so we should not call them very satisfactory.

The greatest change in the history of lighting came with electricity. Ever since 1802, when the first electric battery was made, people had been experimenting with this new source of heat and light and power. As early as 1816 an inventor named Davy made two sticks of carbon glow by connecting them with batteries. His experiment really made the first "electric light," but it was not very satisfactory. Could it be made to work better? Many people wondered and experimented. Inventors were searching for something that would glow more brightly than Davy's carbon and yet not be burned up by the heat when the electric current went through it.

That the inventors were successful in their search, we know. And it was one of America's greatest inventors, Thomas A. Edison, who invented the new lamp, the lamp which turns darkness into light in so many millions of places now. Edison experimented with different kinds of materials that would glow when the electric current was turned on. He first tried thread coated with carbon. Then he tried bamboo. Finally he settled on a metal called *tungsten,* which is used in the lamps you burn today. Not only did Edison invent a lamp which would shine more brightly and for a longer



time than earlier lamps, but he created a new system of wiring and switching. Because of Edison's work, we need no longer be afraid that when the kitchen light is turned off, the lights in the living room and bedroom will go off also. Because of his work, one broken street light will not plunge our whole town in darkness.

With the coming of gas, and later of electricity, there came another very important change in our ways of living. Instead of having each family furnish its own lights, whole communities now have to share in the expense of providing lighting power. The reason is simple. In early times the family made its own candles or bought and tended its own oil lamps. But it would not be easy or efficient for every family to have its own big gas tank or its own electric power plant. Although in some country communities today there are farmers who have their

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Of the street lamps shown here, the first two burned kerosene; the third, gas. The fourth is an old carbon electric light.

own electric generators, it is usually better for all the people of a community to co-operate in getting the power for lighting homes and streets.

Think how the lights of today change our ways of living. Churches, libraries, and theaters are now open and well lighted during the evenings. Merchants advertise their goods with flashing electric signs or with an even newer kind of lighting, neon lights. Neon lights are nothing more than glass tubes filled with a gas which glows with a colored light when an electric current is passed through it. Baseball and football are sometimes played on fields lighted with powerful searchlights called "floodlights" because they flood the dark spaces with brightness. Streets are almost as safe at

Here you see a game of football played at night, under the floodlights which are shown above the field.

night as in the daytime. We have all these lights because inventors have harnessed power to give communities new ways of turning darkness into daylight.

Can You Find Out

When your community put in its first street lights?

When your community started lighting its streets with electricity?

Where the electricity comes from?

How much your community pays each year for street lights?

How many street lights there are in your community?

A Class Visit

Visit the electric light plant or power station in your community.

Drawing Time

Draw a poster showing the improvement of lighting since early times.

Make a List

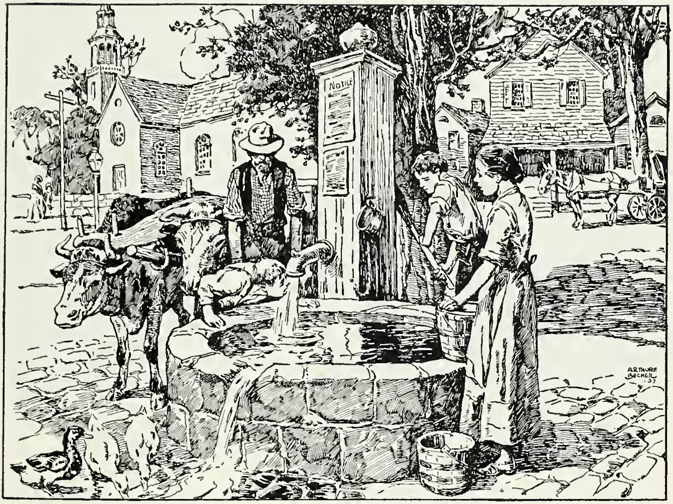
Make a list of all the ways of lighting you know about.

For Your Bulletin Board

Collect pictures showing ways of lighting from early times to now.

8

Getting Water



A Village Pump of Long Ago

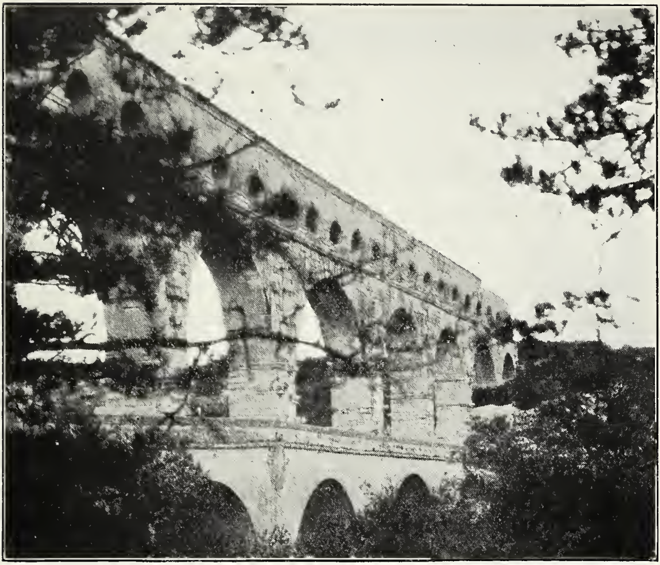
Nathaniel Hawthorne, an American writer who lived about one hundred years ago, once wrote a story about "The Town Pump." He told how the pump overheard all the talk between people who came to the well to get water. In colonial days all the water for use in houses came from springs or wells or streams. A village often had a public well and a "town pump," but many families also had wells of their own.

The problem of how to get enough good water for a community has always been a hard one to solve. In the towns and cities described in the Bible there were village wells. To these wells came all the people, carrying jars to fill with water. Sometimes there were regular water carriers who carried water from the well to the houses. Have you seen pictures of them?

In the cities of Roman times, many cities brought their water from distant springs or lakes. The ancient city of Carthage, in northern Africa, got its drinking water from springs in the mountains thirty-five miles away. To bring the water to Carthage across valleys, a long line of high arches was built, on top of which the channel for the water was made. The channel was a sort of trough, only ten inches wide and ten inches deep. Such a channel, with the great structures which supported it, was called an "aqueduct," a word which means "carrying water." The ruins of many aqueducts are now famous in the landscapes of Europe.

The Roman aqueducts are the most famous in the world. They show us that the Romans worked for many years to build these water channels and keep them in repair. We know that there were at least nineteen aqueducts leading to Rome. Some were short, but one of them was sixty-one miles long. What a vast amount of labor it took to supply the city of Rome with water!

The age of machines has changed the ways of getting the large supply of pure, fresh water that every town



Olive Garrison, from Nesmith

PART OF AN OLD ROMAN AQUEDUCT, still standing in southern France. About how old do you suppose it is?

and city needs. The change came when inventors made better pumps and learned to run them with steam and electricity.

In the year 1582, a Dutch inventor named Peter Moris built sixteen pumps in London. They were worked by a water wheel. At London Bridge his pump could lift 216 gallons of water in one minute from the river Thames to a reservoir, or water container, 120 feet above the river. From this reservoir the water flowed in lead pipes to all parts of the city of London.

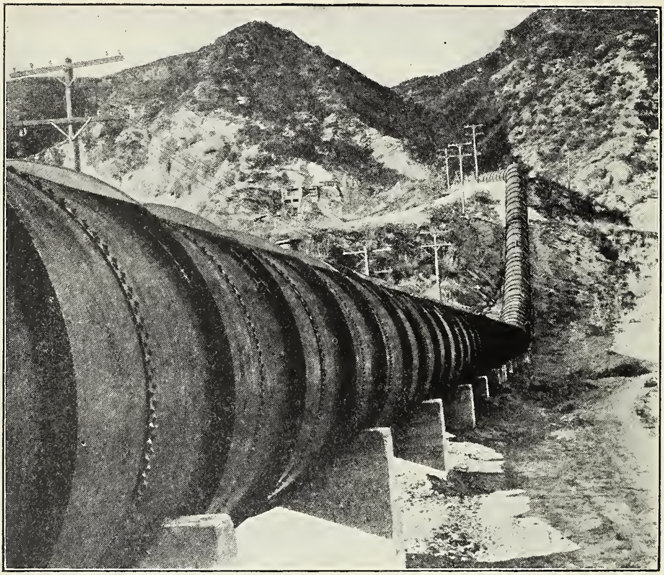
When Boston was founded in 1630, its site was chosen because good springs were to be found there. As the village grew larger, the springs no longer gave enough water. Wells were dug in the yards of homes. Then, in 1652, the town built the first public water-supply system in the American colonies. Water from wells and from near-by streams was carried through the town in pipes made of logs with a hole bored through them lengthwise. The first American city to use pumps to get its water was Bethlehem, Pennsylvania, in the year 1761. The power came from a water wheel. Water was pumped through wooden pipes to a reservoir which was 70 feet high. Providence, Rhode Island, put in a city water system in 1772. After the Revolutionary War, many other cities did the same. As communities grew larger, they found their citizens had to co-operate to get a good supply of water. In cities each family could not depend on its own supply alone.

In 1801 Philadelphia built a water-supply system with a "pumping plant," and fourteen years later a second pumping plant was built. Here were the first steam pumps built in this country. One pump raised the water from the Delaware River to a reservoir fifty feet up the hillside, where a second pump raised the water fifty feet higher. These two Philadelphia steam pumps in 1801 could lift ten times as much water in a day as the London water wheel pumps could in 1582. Don't you think the citizens of Philadelphia must have been proud of their water system?

For a hundred years after New York City was founded, it depended on wells and springs and streams for its water supply. Then a city system was built which carried water to the city from lakes and streams thirty miles away. Now the water comes from several lakes and rivers, some as many as 125 miles from the city. Engineers changed the course of a whole river and made it flow into the New York water supply system. Over seven hundred million gallons a day pour into the city through a tunnel seventeen feet high and ten feet wide. To give any city so large a supply of pure, fresh water, the engineers needed several gifts of our new age of machines:

(1) The strongest and largest steam and electric pumps;
(2) Great machines to make very large pipes;
(3) Machines to crush stone and grind it to fine powder for cement;
(4) Many special machines to make pipe joints, fittings, and faucets;
(5) New knowledge of how water flows through pipes and how it behaves in pumps;
(6) New knowledge about concrete and steel.

With these new kinds of machines, new power, new materials, and new knowledge, the engineers are giving other large cities enormous supplies of good water. Chicago gets its drinking water from Lake Michigan, miles from the shore. San Francisco takes water from the Hetch Hetchy Valley, about 200 miles away in the Sierra Nevada. Los Angeles reaches 250 miles across

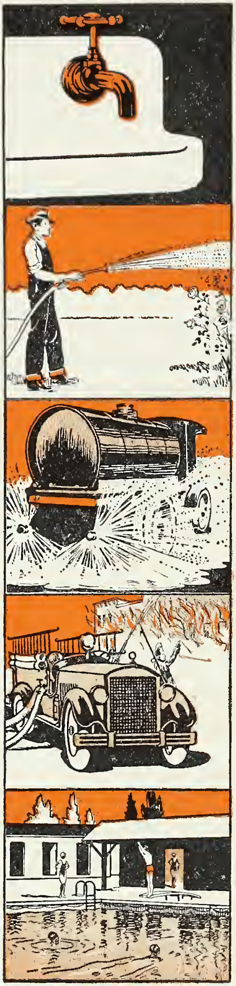


This aqueduct carries the water supply of Los Angeles.

the Mojave (mō-hä′vȧ) Desert to the Owens River, near Mt. Whitney, for its water supply. The longest modern aqueduct in the world brings a billion gallons of water a day to southern California from the Colorado River 300 miles away, through 107 miles of tunnels. The great steel and concrete pipes are 16 feet across. The water flows at the rate of 1,600 cubic feet in a second. The Roman aqueducts carried only four cubic feet a second.

When the water reaches our cities through these great pipes, it is carried to thousands of factories, office buildings, and homes by many miles of smaller pipes. Often it is pumped by very strong steam and electric pumps to the tops of skyscrapers, or to reservoirs and tanks on hilltops which are higher than the buildings where the water is to be used. Then the weight of the water in the long pipes reaching up to the tanks will push a good stream out of the faucets. This is called having a good "water pressure."

To make sure that the water supply for cities and towns is safe to drink, city and state boards of health compel those who run the waterworks to obey laws to keep the water pure. State health officers inspect the rivers and lakes from which the drinking water is taken, and the tanks and reservoirs where it is stored. The health boards examine the water to see that it is pure enough to drink. Many cities make the



What uses of the city water supply do these pictures show? What other uses do you know?

drinking water safe by putting small amounts of harmless chemicals into it or by spraying the water into the air. Many other cities filter the water through beds of clean sand and gravel to make it fit to drink. The state boards of health also help the people in farming regions to get pure water. They distribute bulletins which tell the people how to dig wells and how to prevent impure water from draining into them.

How convenient it is to go to the faucet and get a glass of water which we know is safe and pure to drink! In thousands of cities and villages there are faucets in the house, a water tap outside for sprinkling the lawn, a fire hydrant near by for protection. Every floor in apartment and office buildings is supplied with water.

The story of water systems is indeed a story of community co-operation in the age of machines.

Taking a Trip

If you live in a city, arrange to visit the waterworks. While you are there, see if you can find out how many gallons of water your city uses every day. How do the people in your city pay for their water? What do the workers in your city do to keep the water safe for you to drink?

A Class Visitor

Ask the man in charge of the water system of your community to visit your class and tell about the water system.

9

What Shall We Do with the Garbage?

Ruth was washing dishes for the first time since she had come to visit her Aunt Mildred and Uncle Roy in the city. When she had gathered up the scraps left from the meal, she looked very much puzzled.

"What do you do with the garbage, Aunt Mildred?" she asked. "You have no hens or pigs to feed it to, and no place to burn it, for you haven't a coal stove or a fireplace, and your furnace burns oil."

"If you will put it in that large covered pail out on the back porch, a man will come later and take it away," said her aunt.

"Where does he take it?" asked Ruth.

"He takes it to a place which we call the city reduction plant, where all the wastes of the city are taken. The reduction plant divides or reduces the garbage into several different things. Workers pour certain chemicals over it to take out the oils and greases. These oils and greases can be used for making excellent soaps and perfumes. What is left after the greases are taken out is sold to farmers near the city, who use it for fertilizer to make rich soil in their gardens."

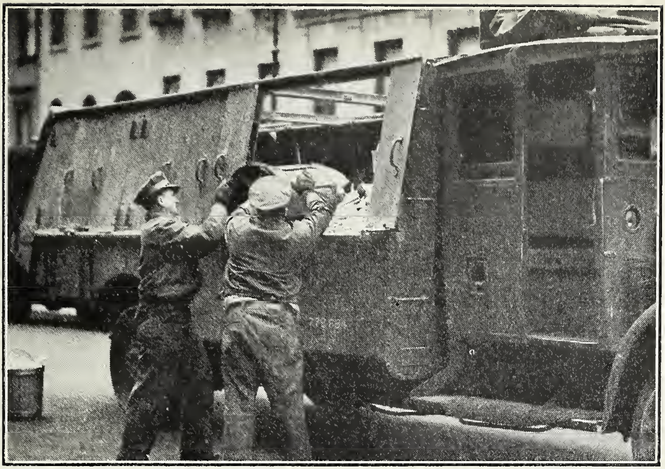
"I never heard of such a thing!" exclaimed Ruth. "At home in the country we give garbage to the pigs and chickens."

"City garbage would not be good for your pigs, Ruth. It is usually either burned or treated with chemicals. In smaller cities where there isn't so much garbage, it is covered with sand or with chemicals which kill the germs. In New York City most of the garbage is burned in great furnaces. The chief thing is to take garbage away quickly, because uncovered garbage soon becomes a breeding place for flies and disease germs which make people ill. One of the big problems of any city is to get rid of its garbage. In olden times it was often thrown into the streets, but there it caused bad odors and bred disease. Thanks to modern inventions, we have better ways of getting rid of it.

"Some cities send men out to collect waste paper, tin cans, and ashes, too. Much of the dry rubbish of our city, as well as some of the reduced or purified garbage, is taken to the city dump or marsh land and used to make solid ground. Part of Chicago's beautiful lake front was made that way."

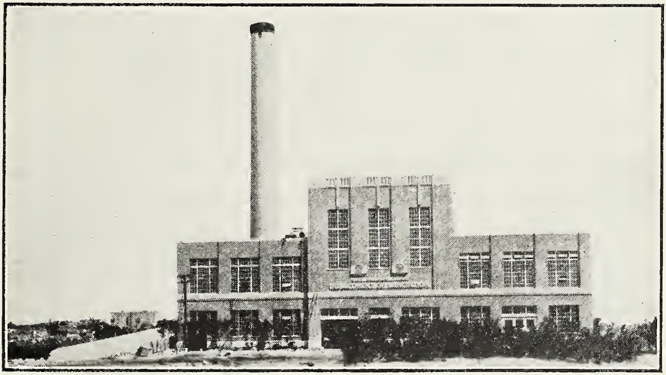
"Where does the water from the sink go?" asked Ruth.

"In city houses," said her aunt, "most of the waste from sink and bathroom is carried from the house by pipes. These pipes run into larger pipes called *sewers.* There are sewers under most of the city streets. Some of them are very large. They drain the waste away, and let it run through sand filters into a river or some other large body of water."



Ewing Galloway

Garbage, left in large cans on the sidewalk, is loaded on automobile trucks and carried away to incinerators.



Fairbanks

This picture shows a large incinerator, or building where garbage is burned in great furnaces. In such a building many tons of city garbage are burned each day.

How to Get Rid of Garbage in a Large City

"What a lot of pipes there must be under the ground in this city!" said Ruth.

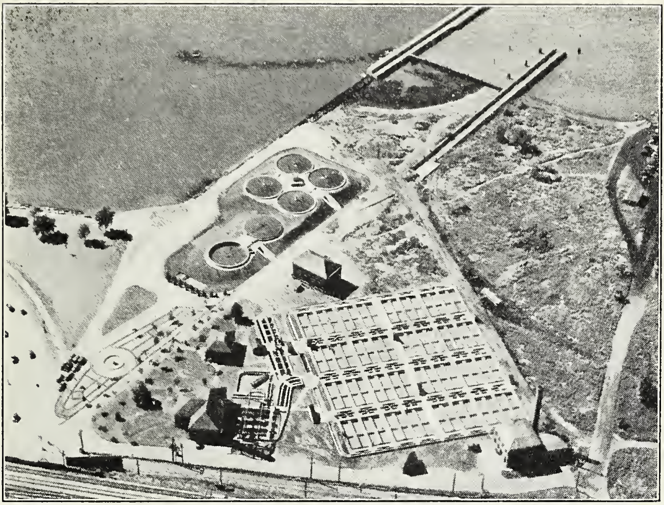
"Think of a huge sewer running under each of the main streets of our city, Ruth, and of many smaller pipes draining into it from the houses on each side. While we were out walking yesterday, you spoke about the iron gratings on the streets. They are openings to the large sewer pipes, and are the places where the rain water and wastes from the streets are drained."

"Yes," said Ruth. "I remember them, and I noticed some round iron covers on the street and an opening in the ground where there was a sign, 'Open Manhole.' Was that an entrance to the sewer drain, too?" asked Ruth.

"It is one of the many manholes or openings which have to be made so that the sewer drains can be repaired. Often sewer pipes become clogged, and after heavy rains they may overflow. These pipes in the sewer system have to carry away about 200 gallons of waste a day, on the average, for each man, woman, and child in the city. The building and repairing of sewers and running the sewage disposal plant keeps many men busy. It is one of the chief tasks of the city."

"What do you mean by a sewage disposal plant? Is it like a garbage reduction plant?" asked Ruth.

"Well, the two are somewhat alike," answered Aunt Mildred. "On the edge of our city is a big round brick and cement building. That is the place where all the waste of the city goes, and is called the sewage disposal



Fairbanks

SEWAGE DISPOSAL PLANT IN CLEVELAND, as seen from an airplane. Notice the reservoirs in which the sewage is treated.

plant. Near the plant is a large reservoir. Chemicals are mixed with the sewage in this tank to kill the disease germs and to turn the sewage into liquid form. This liquid is next made to flow from one tank to another and it is strained carefully. The liquid is then sprayed into the air through a series of small fountains. It falls on beds of crushed rock and sand. In filtering through the rock and sand it is strained and cleaned. It is then drained through huge tunnels into the river.

"Do all cities have sewage disposal plants like this one?" asked Ruth.

"No, not all cities take care of their sewage in the same way," answered Aunt Mildred. "This method is a very good one, and it is now used by many American cities. Baltimore and New Orleans were two of the first cities to build such disposal plants."

Uncle Roy, who had been listening to the conversation, spoke up and said, "Sewage, as the waste which drains into the sewers is called, is a breeding ground for disease germs, and the city has to be very careful in order to make sure that it is properly and safely carried away. Most people today realize how important it is to dispose of garbage and sewage waste. Even in summer camps people take care of them by burying them or covering them with chemicals.

"Many years ago the people who live along the Merrimack River, in Massachusetts, learned an important lesson about the disposal of sewage and garbage. You know about Lowell, the 'Spindle City.' On the river below Lowell is the city of Lawrence, and above Lowell are Concord and Manchester, in New Hampshire. All of these cities were dumping their sewage into the Merrimack River and all of them were getting their city water supply from the same river. The drinking water looked all right, but—

"In 1885 there were many, many cases of typhoid fever in Lawrence. People were greatly alarmed. Then the public health officials of the state began to investigate. They found that whenever there was a case of typhoid fever in Concord, there were a few more cases in Manchester, more in Lowell, and a great many cases in Lawrence, which was farthest down the river. They soon found that the typhoid germs were in the drinking water, and that they came from the sewage which the cities were dumping into the river. Experiments were made to learn how to purify the water, and filtering systems were built for the sewage. Soon the cases of typhoid were fewer and fewer. Other cities, too, were soon taking better care of their sewage.

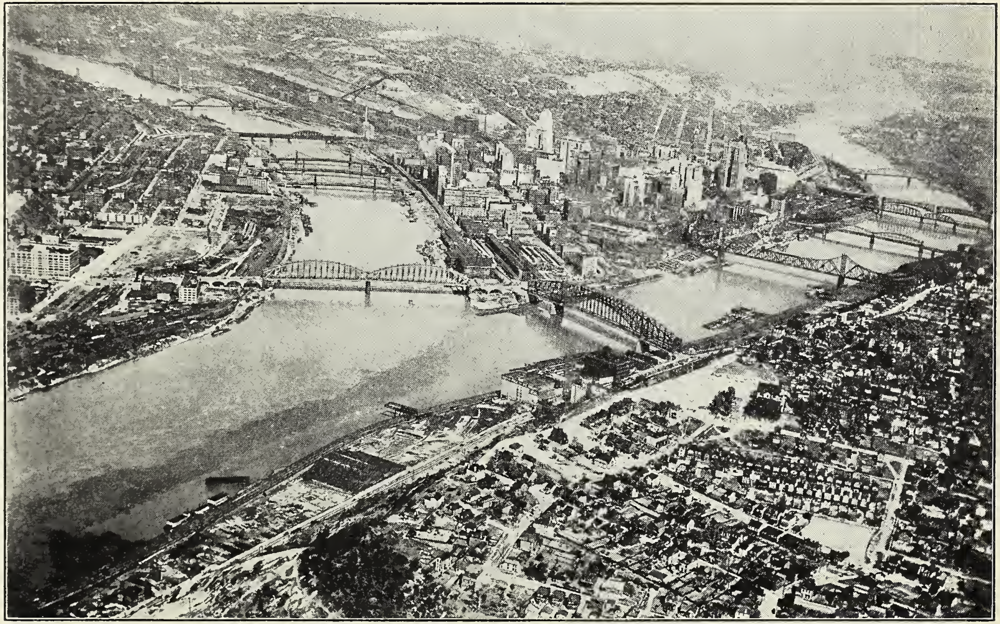
"As cities have grown during the machine age," continued Uncle Roy, "the problem of handling garbage and sewage has become very important. But, thanks to the chemists and the inventors, we can now take care of the problem if we really go about it right."

Talking Time

In the Middle Ages the people in towns and villages threw the garbage into the street. The cooks and kitchen boys working in the castles sometimes threw the garbage into the moat that surrounded the castle. Imagine that you can go back to the Middle Ages to make a visit. Tell what you think about the "garbage disposal" of those times.

Make a List

Make a list of the benefits that come to us because we have found good ways of getting rid of the garbage.



© *Trinity Court Studio*

AIRPLANE VIEW OF PITTSBURGH

10

Getting about Town

When New Amsterdam was really "new," it was an easy matter for the good folk of the village to "get about town." A short walk along one or two quiet lanes would take the Dutch housewife from one end of the settlement to the other. Before she knew it, she would be leaving behind her the village green and the last small house and heading into the open countryside. Even when New Amsterdam became New York one could walk through all its streets in a short time.

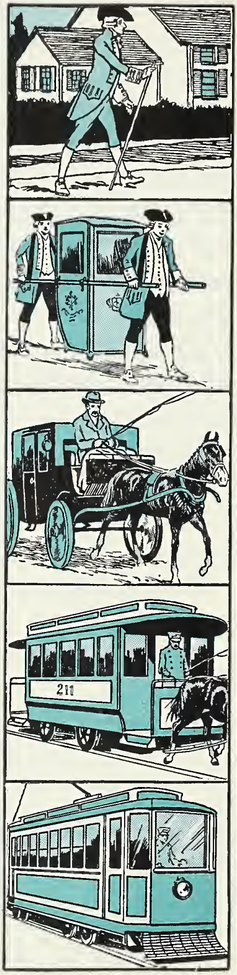
As more and more settlers came to live in New York, the town grew rapidly. Its streets spread out on every side. It pushed its way up hills and across rivers. Buildings sprang up everywhere. At last the city covered so many miles that even a rapid walker would need many hours to travel through it on foot. It would take several days now to walk around the boundary of the city.

Today in every large city of the country there are blocks of houses and stores, with schools and parks, theaters and libraries, churches and office buildings scattered among them. Each day the people who live in the city have to be able to get from one part of it to another.

When Mrs. Brown, who lives on the very edge of the city, wants to go shopping, she has to get from her house to the department stores, which are many blocks away. Mr. Brown every morning has to get from his house to the office where he works. Bobby Brown has to go several blocks to high school, and Betty Brown to grammar school. In a large city there are a great many people like the Browns—thousands and thousands of them, in fact. The distances they have to cover every day right within their own city are too great for them to walk. Something has to be done to take them where they want to go and bring them home again. The task of carrying people from place to place in a city is the task of "local transportation."

The first means of local transportation, of course, was walking. Later many people rode on horseback, or perhaps in their own buggies or carriages. Finally there came "public carriages" which would carry people from place to place for a small fare. Then someone got the idea of building tracks in the middle of the street for the public carriages to travel on. When the carriages rolled along the tracks, they could be pulled more easily and swiftly. Gradually the carriages became longer so as to hold more people. They began to look like the streetcars we know today. For many years these long carriages or streetcars in all the chief cities of Europe and America were drawn by horses, pulling steadily between the tracks. Women who went shopping went in these "horsecars." The horsecars carried men to and from work. After electric dynamos and motors were built, many inventors began to experiment with electric cars. It is not certain who really invented the first practical electric streetcar. One was shown in Berlin, Germany, in 1879. The next year, in the United States, Edison made an electric car that would work. In the 1880's F. J. Sprague, of Richmond, Virginia, got the idea of trolleys, the long arms that reach from the cars to the wires overhead. Soon horsecars disappeared and electric trolley cars, getting their power from wires hung above the streets, began to take their places.

But as cities continued to grow, not even the electric trolley cars running on smooth steel tracks could take care of all the local transportation. The streets also



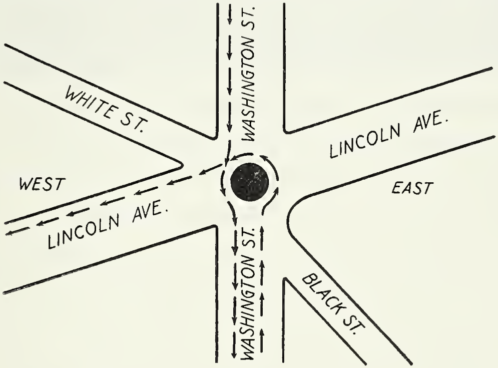
The pictures here show ways of local transportation, from early times till recent times. What can you tell about each picture?

became more crowded with people and buggies and wagons. Then the "horseless carriage," the automobile, was invented. When automobiles and motor trucks appeared in great numbers on city streets the traffic was worse than ever. At busy corners when everybody tried to move at once there were bad traffic jams. It became necessary to make people wait at street crossings, and to take turns getting across. Policemen stood at the crossings and told the people and motorists and streetcar drivers when to go and when to stand still. Then a clever inventor built an "electric policeman" that turned on a red light when motor traffic should stop, and a green one when it could go. In some towns, yellow lights tell walkers when they may cross the street safely. Today in every large city traffic lights help traffic to move easily.

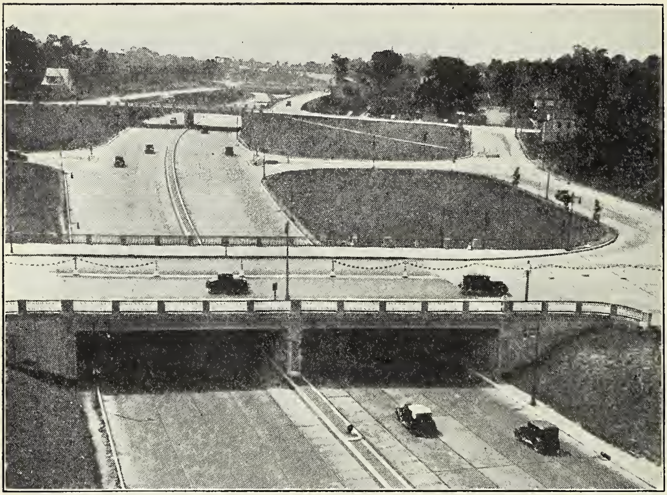
There is also a plan called "rotary traffic" that helps to prevent traffic jams when several roads come together at one point. The word "rotary" means turning around. In rotary traffic, all the automobiles go around in a circle in the same direction—to the right. When nobody makes a left turn but goes around the circle until the turn he wants to make becomes a right turn, it is safer for everybody. If you will look at the diagram on page 449 you will see how rotary traffic works.

In addition to the traffic lights and rotary traffic, someone had the idea of building overpasses and underpasses where two busy roadways cross. A street going north and south tunnels underneath one going east and west, or climbs over it on a bridge. In this way the traffic on both streets can keep on going and does not need to stop at lights and take turns making the crossing. This method of making crossings safe was first used where railroads crossed a street; today it is often used for motor roads as shown in the picture on page 450.

As modern cities, such as Chicago and New York, grew to enormous size, the problem of local transportation in them became more difficult. With hundreds and thousands of people rushing to get to the center



In this diagram, Washington Street and Lincoln Avenue cross, and two smaller streets, Black and White, come in at the same point like spokes in a wheel. With rotary traffic, a motorist driving north on Washington Street who wishes to turn left into Lincoln Avenue, must first circle to the right around the center of the hub until he can turn *right* on Lincoln Avenue. If he did not do this, he would get in the way of the motorist who is driving from north to south on Washington Street.



Ewing Galloway

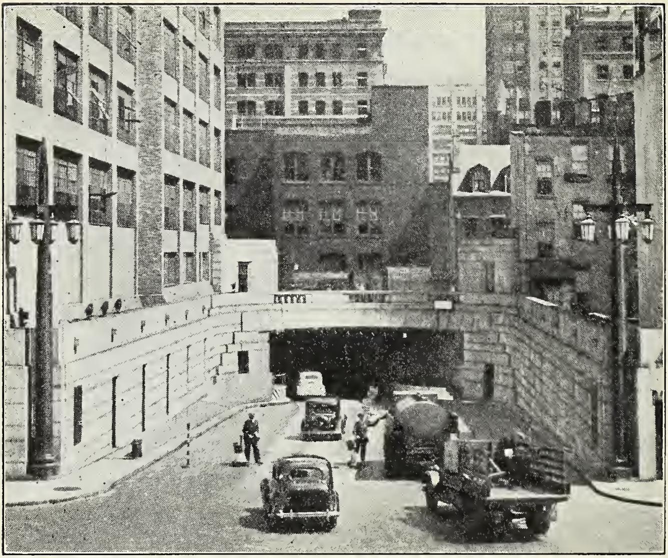
OVERPASSES on streets crossing a main highway in New Jersey.

of the city in the morning and all trying to return to their homes at the same time at night, streetcar transportation, and later even automobile transportation, seemed too slow. The only possible thing was to go up in the air or burrow tunnels underneath the ground. And that is exactly what the city planners did to help people get about town quickly and easily. They built tracks high up in the air on strong steel pillars, and along these tracks they ran heavy electric trains that got their electric power through a third rail underneath the train, instead of from a trolley wire overhead. Because these trains were on private roads of their own, traffic could not get in their way.

They could move rapidly and carry people swiftly to the heart of the city and back.

Overhead railways, or "elevateds," however, are noisy, and they make the street below dark and gloomy. So, wherever possible, instead of putting the tracks up in the air, the engineers began to dig tunnels underneath the city. In them electric trains sped along out of sight and hearing of the people in the streets. But building tunnels, or "subways," is not so easy as it sounds. The engineers met with all sorts of difficulties. They had to keep the floor of the city propped up safely while they dug beneath it, and they had to solve the difficult problem of forcing fresh air into the tunnels after they were dug. They finally hit on the plan of using giant fans to draw air into the holes and keep it moving. In London there is an underground railway which has a fan five feet thick and twenty feet wide, with other fans placed every half mile at openings in the tunnel. In Boston the fans completely change the air in the subways every fifteen minutes. The fresh air enters at the stations and the stale air goes out at openings half way between the stations.

When a growing city has pushed its way across wide rivers and harbors, local transportation is even harder because trains and streetcars must cross the water. Cities of the machine age have solved the problem in several ways. Sometimes cities build huge bridges, costing millions of dollars, to carry trains and automobiles and walkers across the water. One of the most



James Sanders

ENTRANCE TO THE HOLLAND TUNNEL, crossing the Hudson River.

wonderful bridges in the world is the new bridge across the harbor at San Francisco (page 149). Sometimes ferryboats run back and forth from shore to shore. One of the most difficult things that can be done is to tunnel underneath a river or harbor. It took twenty-nine years to build one of the tunnels under the Hudson River at New York City, but since then it has been used for speedy transportation by millions of people.

Automobiles, busses, trolley cars, elevated trains, subways—all of these have been given to us by the age of machines. With them, people can live long distances from their work. Going from place to place in a city of today is easy and rapid because of good local transportation.

The Bulletin Board

What pictures have you been putting on the Bulletin Board and in notebooks while you have been studying about communities in the age of machines? See if you can get pictures which show how people have been "getting about town" from the earliest days of your community to now. Often the Sunday papers have interesting articles and pictures of earlier days in your community. Maybe you can find information and pictures in these articles. Of course you will have no trouble finding pictures that show how people "get about town" today.

Traffic Problems

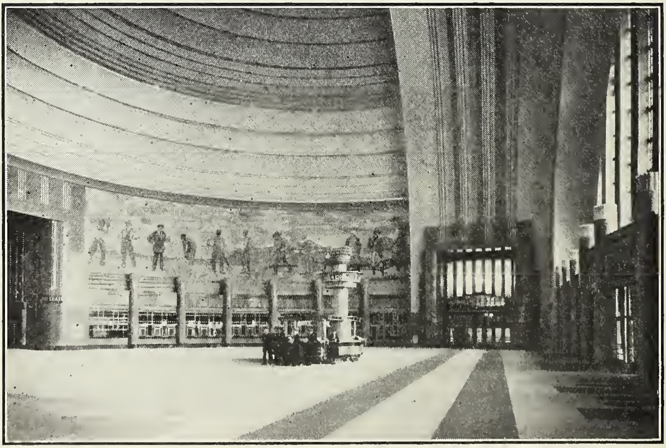
Watch the traffic in your city. Read about your city's traffic in the newspapers. What are the greatest traffic problems of your city? What is your city doing to solve those traffic problems? Can you think of places where overpasses or underpasses would help? Count the number of cars which pass your school during one class period.

11

Suppose Washington Should Come

Suppose George Washington could come to life again and visit the country he helped to start. In 1789, when he became first President of the United States, the largest city here had fewer than 50,000 people in it. But today we have many large cities. More and more people are earning their living in factories.

In many ways, too, the age of power and machines has made both large and small communities more pleas-



Acme

Here you see part of a fine large room in the railroad station in Cincinnati. Notice the people standing near the center.

ant and comfortable and convenient to live in. What do you think of the ideas in this chart?

In Washington's Day	*Today*
1. City streets were not paved, except for a few cobblestone roads;	1. Every city has miles of paving —macadam, brick, wood blocks, concrete;
2. There were no street lamps, and towns were dark and gloomy at night;	2. Our city streets are lighted with thousands of electric bulbs;
3. Railroad stations were unknown;	3. Every city has one or more railroad stations for passengers and freight;
4. Drinking water came from wells and springs;	4. Drinking water is brought into our houses by miles of pipes;
5. Men traveled about town on foot or on horseback, or occasionally in a coach;	5. People travel about town easily on bicycles, automobiles, busses, trolley cars, elevated or subway railroads;
6. There was no real farm machinery;	6. Prosperous farmers have as many mechanical helpers as city dwellers have;
7. People were not so dependent upon one another.	7. The people of a community have to co-operate to secure food, water, clothing, shelter, and transportation.

Can you add more items to the list in the chart showing how, in many ways, community life has been greatly improved by the coming of the machine age?

But if George Washington should visit us today, he would not think that all the changes which have occurred in our communities are really improvements. He would see that the age of machines has given us new problems as well as new conveniences. The small cities that George Washington knew did not have such slums as most modern cities have. Neither did they have as much smoke and noise! We cannot understand all the changes the age of machines has made in our communities until we understand some of the problems of city life also. The next stories in this book will tell you of some of the problems.

Abigail Visits Our City

Imagine that Abigail Pennington, the girl of colonial times, comes to visit your city. Write a short story telling what Abigail notices and says about the comforts and conveniences of your town.

A Map of Community Conveniences

Can you make a map of your city showing where these places are located?

The main streets
The waterworks
The garbage-disposal plant
The railroad stations
The car barns
The main bus stations
The station or stations of the power plant

Reading Time

These books tell stories about community conveniences:

Carpenter, Frank G., and Carpenter, Frances, *The Houses We Live In.*

Carpenter, Frances, *Ourselves and Our City.*
Eaton, Jeanette, *The Story of Light.*
Holway, Hope, *The Story of Water Supply* (Pictures by Elmer Hader).
Lacey, Ida Belle, *Light Then and Now.*
Rugg, Harold O., and Krueger, Louise, *Communities of Men.*
Unit Study Books, No. 305: *The Story of Heat.*
Unit Study Books, No. 408: *Light.*
Unit Study Books, No. 455: *Water, Its Sources and Uses.*
Williams, Archibald, *Engineering Feats.*

Talking Time

Look in books about communities for stories of the conveniences we can have because we live together and co-operate in this age of machines. Here are some stories that you might like to report on.

"How the Community Gets Its Water," Rugg and Krueger, *Communities of Men,* pages 132–145, and Carpenter and Carpenter, *The Houses We Live In,* pages 133–142.

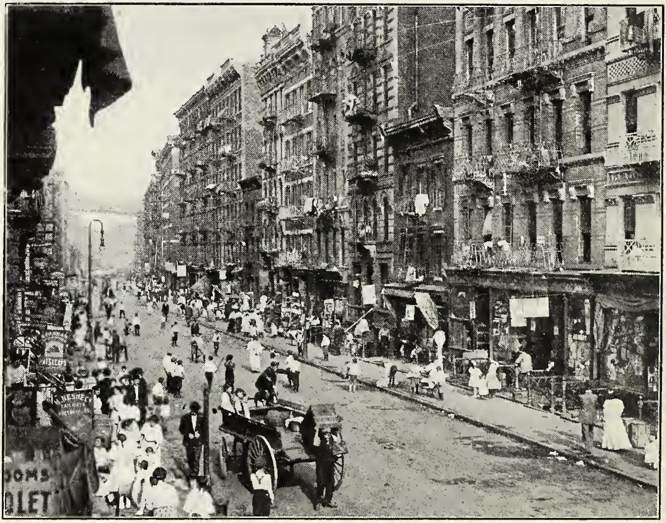
"How Our City Keeps Clean," Carpenter, *Ourselves and Our City,* pages 55–69.

For a story on "Street Lighting," see Ida B. Lacey's *Light Then and Now,* Chapter XII.

"How We Travel about the City," Carpenter's *The Ways We Travel,* pages 119–135.

12

Harry's Home



Brown Bros.

TENEMENT HOUSES of about thirty years ago, in a large city.

School was dismissed for the day, and Harry started to go home. As he ran through the narrow streets, he had to pick his way among crowds of noisy children, peddlers' carts, and heaps of dirty rubbish. It had rained that day, and the water stood in muddy pools on the broken sidewalks and unpaved streets. The streets were lined on both sides by high frame buildings called *tenement* houses. Harry's home was in a tenement.

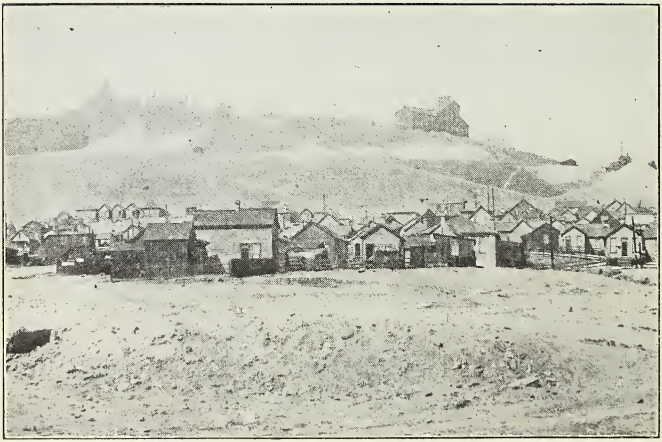
To reach the tiny one-room apartment in which he lived, Harry had to climb up three flights of stairs and go down to the end of a long hall so dark that he had to feel for the doorknob. Harry always hated to go along the hallway.

The room was as clean as his mother could make it, but the roof had leaked, and big patches of spotted and damp paper made the walls look very dirty. There was a shabby iron bed in one corner. Piled on top of it was a mattress which was put down on the floor at night for Harry and his brothers to sleep on. A line of steaming clothes was stretched above the cookstove, because there was no other place for them to dry. They made the air very stuffy. There was no sink in the room, and a pail of water always stood on the table. The floor was bare, and the few chairs in the room were just common straight ones, not a soft comfortable one among them!

Most of the boys with whom Harry went to school lived in homes like his. Some of them lived in apartments or in tenements of only two or three rooms. Some of the rooms had no windows in them, and most of the buildings were in need of repair.

Are you wondering why so many people were living in such crowded, shabby homes? When you were reading the stories which told how large cities and towns grew up around seaports and factories and mines, did you stop to think where the people lived when they came to work in these busy centers? Thousands and thousands of people coming to live together in rapidly growing cities made a difficult housing problem. There were not enough houses for the workers to live in. Too many families were crowded in small spaces, for most of the people wanted to live close to the factories or mills or mines where they worked.

Close to the factories and mills and mines, cheap wooden houses were built. The houses were often built in rows very close together, usually one house for several families. Often many tenements were built



Brown Bros.

EARLY HOMES OF MINE WORKERS, thirty or forty years ago. Notice how close together they were built. See also, beyond them, the paths leading to the mines and the big buildings where the men had to work.

together in long rows. The houses were just alike and very ugly. At first the houses had no sewers or sidewalks, and the streets around them were not paved. There was no garbage collection or street cleaning, and the air was filled with smoke and soot and gas from the mills and factories.

In the towns and cities early in the machine age, new houses could not be put up fast enough to care for the workers. People who owned old houses divided them into small apartments and rented them to other families. The neighborhoods became very crowded, for where one family had lived there were now three or even five families. The houses that had been built for one family did not have enough plumbing or windows to take care of many families. Gradually, between houses or on vacant lots, cheap frame or brick tenement houses were built until the streets in these neighborhoods were lined with buildings. In large cities, crowded districts where the houses and tenements are old and poor are called *slums*. Harry's home was in the slums of a large city.

The people who lived in the slums found it very hard to keep their homes clean. Since the houses had little plumbing, some of the families had to get their water from outside their rooms. Because whole families had to live in a few small rooms, they had to have beds and mattresses in every room. Many men came to work in the factories without their families, and had to board in the homes of other workmen.

Roomers made some homes even more crowded. With water hard to get, very little sunlight or fresh air, with crowded rooms and dirty streets, mothers found it difficult to be good housekeepers. Because of the unsanitary conditions, diseases spread easily from family to family.

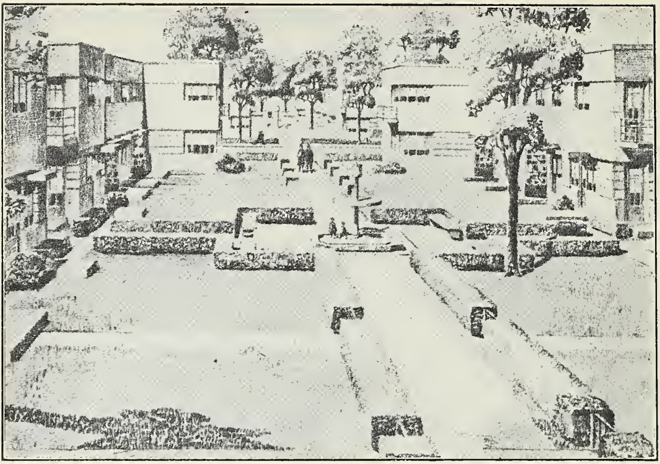
When Harry was a boy, about 1890, few of the good things that made other parts of the cities comfortable and beautiful could be found in the slums. There were no parks or playgrounds, often not even trees and gardens. There were no libraries, no good theaters, no museums in the slums. But there were a great many saloons and gambling houses where criminals found good hiding places. In 1890 great numbers of people in the United States were living in the slums of large cities. To them the coming of the age of machines had brought not only jobs in factories but bad living conditions.

To have so many people living in such unsanitary places was not good for the nation. To be good citizens people must live in comfortable, clean, and happy homes. Small groups of citizens began to realize that the slums ought to be done away with. In New York City the "Council of Hygiene and Public Health" started to clean up the slums there. In 1867 it persuaded the lawmakers of the state of New York to pass the Tenement House Act. This act was the first law passed in America to improve the houses of the workingmen. When it was passed, people were beginning in earnest to try to solve the problem of the living conditions of factory workers.

Following the Tenement House Act of 1867, more housing laws were passed in New York and in other states of our country. Laws were passed which required that every room must have a window. Every floor of a tenement house must have at least one sink with running water. Outside toilets had to be done away with in many places. Fire escapes were required. Communities were forced to make playgrounds and parks. But how hard the reformers had to work to bring about these improvements! For instance, it took eight long years, from 1887 to 1895, to put into practice the law which required running water on every floor of a tenement. Many property owners fought long and hard against every new law for better housing.

But the people who were interested in making the slums better places to live in went right ahead with their work. Jane Addams, a woman who lived in Chicago, became interested in improving homes for workers. Jacob Riis (rēs), a newspaper man in New York City, wrote a book called *How the Other Half Lives,* which made thousands of people all over the country anxious to get rid of the slums.

People were getting better ideas about how to build houses. They began to talk of tearing down the slums and putting up new, well-lighted, and well-ventilated apartment buildings in their place. Better means of local transportation were making it possible for workers



Courtesy The Architectural Forum

RECENTLY PLANNED HOMES FOR WORKERS. Notice the large court provided in this plan, which is one of those made for the Housing Division of the Public Works Administration.

to live farther away from the factories. Many workers moved from the slums to the edge of the city and built or rented houses of their own, where they could have yards and little gardens. Some large factories built special villages for their workers. The attractive town of Mariemont (mā′rē-mŏnt), Ohio, was built by a wealthy woman, Mary Emery, who was interested in better housing. A railroad company built the very attractive town of Kingsport, Tennessee, for workers. Akron Heights was started by a rubber-tire company. When the owners of steel mills built Gary, Indiana, they built good houses for the workers.

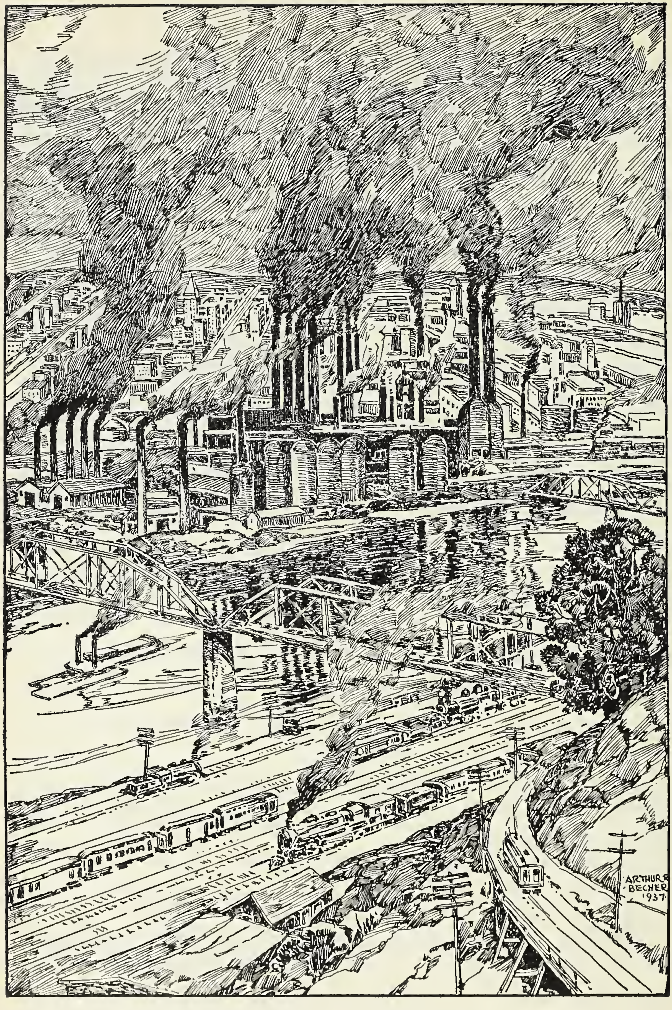
As time went on, more and more people worked to make housing better. City and state governments began to help. Finally the United States government became interested. Today, over the radio and in the newspapers and magazines, we hear and read about new building projects. Some of the large slums are being torn away and new apartment homes are taking their place. In the suburbs and even farther out in the country "garden cities" are being planned and built. But we must not forget about Harry, the boy whose home was in the slums. By this time he has long been a man, perhaps the father of a family. It is quite possible that his family is planning to move into a new apartment, such as they have never had before, with plenty of sunshine, fresh air, a bathroom, a roof garden, and a playground. Or, do you want them to move out to their own home in a garden city in the country?

Find Out

Are there any tenements in your city? Find out what the laws in your city or community are about building houses.

A Summary

Write a summary of the main ideas in this story.



Many cities see much smoke from factories, ships, and trains.

13

Dirt, Odors, and Noise

DIRT

If, some sunny day, you were to climb to the top of a tall building in Chicago on the shore of Lake Michigan and look out of windows to the north and east, you would see the blue waters of the lake stretching away for miles. You could see far into the distance because the air is clear over the water. But if you turned to a west window and looked out, expecting to see just as far in that direction, you would probably be disappointed. Over the whole city at your feet would hang a smoky veil or haze. It might be so thick that you would not be able to see one third as far as you could to the north and south and east. The haze is made of smoke rising from the chimneys of thousands of factories and homes. It is made also of dust blown about the streets by automobiles. Over the lake the air is often clear, but over the city, smoke and dust often hang like a fog.

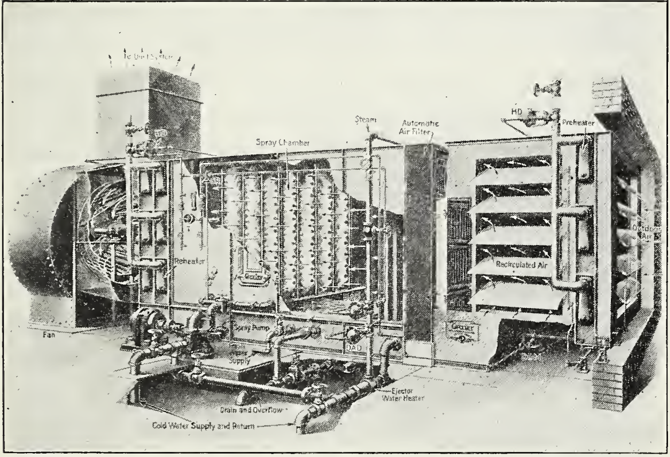
Every city, large or small, has the problem of smoke and dust to face, and many cities seem to be covered with a veil. The thousands of coal and oil fires that warm our homes and make our machines go, pour out millions of clouds of smoke into the air each year. The thousands of automobiles that whiz along our roadways raise large quantities of dust. Smoke and dust and dirt are some of the problems of our machine age.

One interesting thing about smoke is the way it travels. The hot air from the fires carries small bits or particles of unburned material up the chimney and high into the sky above. We call these particles *smoke.* The particles are small and light, and some of them stay in the air for days and days. Millions of the smoke particles gradually settle on our houses and blow in through the windows and doors. You know how black and dirty houses often look that are built along railroad tracks or close to large factories.

Dust, also, is made of particles so small that the winds can easily blow them high and far. Like the smoke particles, too, they settle after a while. They are able to get through very small cracks into our houses. During dry seasons the wind will sometimes turn powdery farm soil into dust and blow it hundreds of miles away.

There are many kinds of dust besides the rock dust blown from the soil or stirred up on roadways by our new ways of transportation. There are many industries which raise much dust in factories. Coal mines, cement works, flour mills, cotton mills—all these raise large amounts of dust. Thousands of workers are obliged to work in the dusty rooms all the time. This dust does not do much harm in our homes or on the streets, but it is sometimes very harmful to the workers because so much of it gets into their lungs as they breathe. Often disease germs are attached to the dust particles, and these cause sickness when breathed into the lungs.

To help get rid of the most dangerous dust, laws have been passed to require special blowers and ventilators to remove the dust in factories. But our modern industries are a long way from being free from dust, even under the best conditions. Dust is another great problem of our machine age. Some office buildings and houses are now planned to keep out as much dust as possible. There are machines which wash the dust



Carrier Eng. Corp.

AN AIR-CONDITIONING UNIT. Air is drawn in at the right, and is heated, cleaned, and properly moistened before being sent through pipes to the various rooms of the building.

out of the air before it goes into the building. The same thing is done with the air which goes into some of our new trains. This is called "air-conditioning." For the comfort of passengers, the air is cooled during the summer season. Theaters, churches, and large halls have air conditioning for the comfort and health of the crowds which go there. Some factories have been compelled to put in special machines which burn up the smoke, or most of it, before it goes out of the chimneys. But even with these improvements, not all of the smoke and dust can be kept out of the air in our cities. Still better methods must be found for getting rid of the dirt the machine age has brought.

ODORS

Passengers on pleasure boats in the harbor of Boston sometimes sniff and make wry faces as they pass a certain island. They do this because the wind is bringing them bad odors from the island where Boston gets rid of its garbage. Odors are a third problem of our machine age. Most of us live where we are not disturbed by the disagreeable smells of certain manufacturing plants. But in our large cities there are thousands of people who live near factories that use ill-smelling materials in their work. Stockyards, gas works, soap factories, sulphur works, glue factories, dye factories, rubber factories, factories which make photographic films, and many other kinds of industries fill the air with disagreeable odors.

Before the age of machines a slaughterhouse or a glue factory was usually located far out on the edge of a town, and a single factory did not make enough of its products to spoil the air of the whole town. But today the production of goods is so great that the odors of some factories are an unpleasant and sometimes a dangerous nuisance.

Other odors come from the waste materials that are dumped out of factories and from some garbage-disposal plants. Still others come from the great dump heaps made of things we throw away. One often sees such dumps covering acres of land between towns. As the towns grow in size, they come near enough to the dumps to be bothered by their bad odors. If you have ever passed a burning dump heap, you will know how bad the smell can be.

City and state health boards have solved some of the problems of odors. The owners of factories are obliged to destroy some of the odors of their manufacturing by using chemicals or burning their waste products. Some factories are required to build very high chimneys to take gases and bad-smelling odors high into the air where the winds will blow them away. But even with these improvements there is much still to be done.

NOISE

In the year 1935, a workshop on wheels came down one of the busiest streets in the world—Broadway in New York City. It was only an open truck full of boxes and batteries and tubes and wires, but it was a workshop just the same, and it stopped, strangely enough, in the very busiest part of the busy street —Times Square.

What could a workshop be doing in that crowded, noisy square? It was not broadcasting music, for nobody could have heard a note above the din made by the shrill cries of street sellers, the honking of automobile horns, the gongs of streetcars, the rumble of subway trains, the whistles of policemen, and the tramp of thousands of hurrying feet. People had to talk loudly to make themselves heard above the noise. It was a queer place to come for work.

The workers in the workshop on wheels, however, did not want quiet. Times Square at its noisiest was exactly what they wished, for the workshop was there for just one thing—to record the many noises of a great city. And after it had recorded the noises of Times Square, the truck went on to other noisy corners of New York City. It stopped under the elevated railway to make a record of the noise made by trains as they roared by overhead. It stopped near factories and machine shops and recorded the pounding of steel hammers and the roar and clatter of hundreds of noisy machines.

Why were these men doing this? They were trying to solve one of the important problems of our new machine age—the problem of noise. Before the age of machines, our towns and even our larger cities

Fairbanks

THIS WORKSHOP ON WHEELS is shown here as it is making a record of city noises. Make a list of all the noises which might be heard at a busy city street corner.

were not nearly so noisy as they are today. To be sure, the workers who used hand tools at home or in the shops made some noise with their hammers and saws, but the shops were small and the workers few in number. The sounds that in those days fell on the workers' ears or came through the windows were small compared with the deafening noises of our large factories today.

As the cities grew larger and busier, the noise grew noisier. At first people did not notice it. But when scientists and doctors discovered that noise keeps workers from doing their best, people began to wonder if something couldn't be done to lessen the noise. Employers made experiments and found that clerks and typists can do more work and make fewer mistakes in quiet rooms than in noisy ones. Factory owners noticed that workers in their factories are likely to become tired and cross when constant noise is a strain on their nerves. Street and railroad noises keep people from getting the sleep they need after a hard day's work. Even when people have learned to sleep through the noise, they do not get the right kind of rest.

And so a number of cities started to find out how to stop some of the worst of the noises—or at least make them less disagreeable. The workshop on wheels was one of the steps New York City took in trying to lessen the street noises. Now, in some city neighborhoods you will see milk wagons with balloon-tired wheels and horses with rubber shoes going about in the early morning. Radios must be turned down at certain hours. Motorists are told not to blow their horns except in emergencies.

Because our new age of machines has given us so many things made of iron and steel, it has also become an age of noise. We have a hard problem to make it less annoying and harmful.

* * * *

Dirt, odors, and noise are special problems which have been brought to us along with all the conveniences and comforts of our age of machines. But these and other troubles are being studied. In many cases the problems are being solved.

Make a List

How many kinds of noise can you hear in your classroom during a day? Make a list on the blackboard of all the kinds of noise. How many of the noises could not have been made in George Washington's time?

Talking Time

Ask your mother whether there is much dirt in your community. What dirt in your community is caused by "the age of machines"? Can you think of any ways to make your community cleaner and quieter?

The Bulletin Board

Can you place on the Bulletin Board pictures or newspaper clippings which show some of the problems the age of machines has brought to our communities?

14

Places in Which to Play

Ewing Galloway

Playing volley ball, on a city playground in Florida.

"You're it!" . . "Strike three! You're out!"

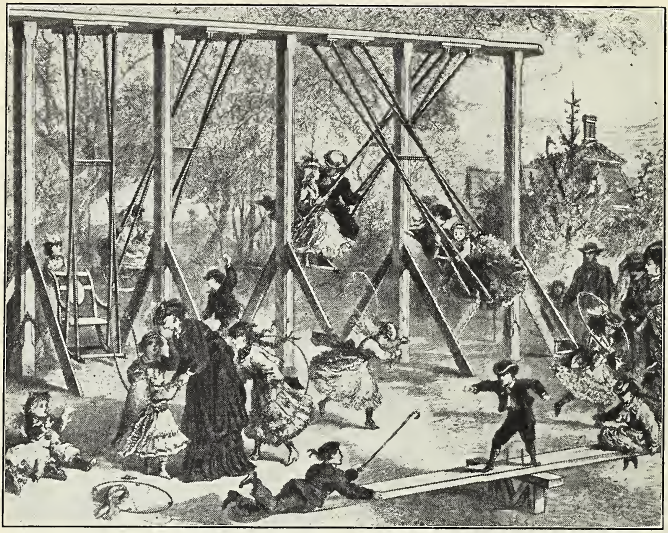
"Thirty-love."

These and many other happy sounds come from the many playgrounds of our vast country. Playgrounds are so common in most parts of the United States today that it is hard to believe that there was a time when people living in our cities had no place in which to play.

In the early days of American life, the village green was a good playground. You have read how Bowling Green was once used as a playground in New York. Boston and many other cities also had similar "greens" or "commons." But as the factories brought more and more people to the towns and cities, the greens were too small to serve as playgrounds for many. Sometimes they were cut up for building lots. The problem of where the people of the city could play became a very difficult one. In many places, especially in the slums, the children had to play in the narrow, dirty, noisy streets. For a long time no one did anything to solve the difficult problem of places in which to play—a problem which the machine age had brought.

When the very famous Central Park of New York City was opened about 1860, there were other parks scattered here and there throughout our growing cities. But in those days parks were not playgrounds. As people walked along the well-kept paths, little signs told them to "Keep Off the Grass." Today, in those very parks and in others, too, the little signs are gone. Instead, people are invited to come and play in very attractive playgrounds especially planned for them.

The members of the First Church of Boston took great interest in making a place for city children to play in. They started a playground in 1885, in the yard of a Boston public school. A little later, someone else in



Culver Service

AN OLD-FASHIONED CITY PLAYGROUND. In what ways is the playground of your school different from this one? How has the equipment changed? How have the play-clothes changed?

Boston thought of putting piles of sand in yards where there was a little shade in the crowded sections of the city. The children of those sections were invited to play in the sand. How much more fun it was to sit in the cool sand in a shady spot than to play on the hot pavement in the sun! Soon story hours, games, and singing were added to the fun in the sand pile, and the sand-pile yards grew into much larger playgrounds.

The picture on this page will give you an idea of what these early playgrounds looked like. In playgrounds today we have swings, slides, teeter-totters, travelers, and many other things for use in play. The very first playground to have such things was opened about 1894 at Hull House in Chicago, Illinois. Hull House is a settlement house which was started by Jane Addams in the slums of Chicago. A *settlement house* is managed by people called *social workers,* who live there and try to make life happier for the people living in slums. The social workers at Hull House saw how much the children around them needed a place in which to

Carl Klein, from Fairbanks

Here you see girls in a settlement house, acting nursery rhymes. Which do you like best—outdoor play, or play on a stage?

play, and they built an excellent playground supplied with all kinds of interesting playthings.

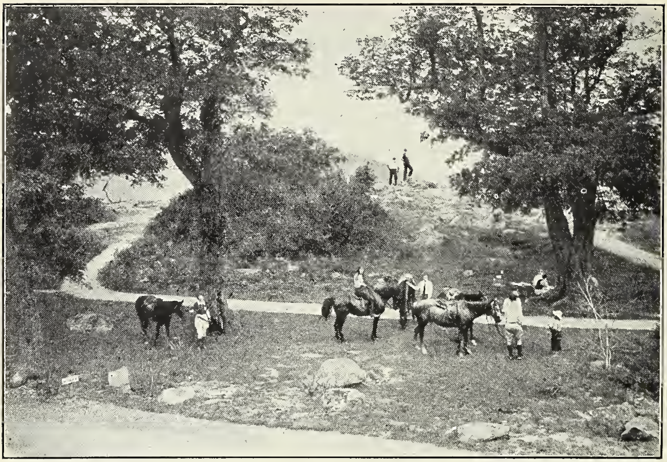
Finally, playgrounds began to appear in other cities. Churches, settlement houses, school boards, and city governments became interested in making playgrounds for the children of the city and for their parents. The Board of Education of New York City ordered thirty-one playgrounds to be constructed at one time! About that time the National League of baseball clubs was started, and League ball parks were built in many cities. Almost every boy and young man from one end of the country to the other wanted to play baseball. So almost every large playground contained a baseball diamond along with a place for ring games, swings and travelers, a shelter for story hours, and a sand box. Since the factories were making good iron and steel, it was easy to get strong equipment for playgrounds.

Playgrounds finally began to appear not only in the crowded areas of our cities but in many other neighborhoods. One of the earliest and best of the neighborhood parks was built in Louisville, Kentucky, in 1900. Besides the outdoor playgrounds, most neighborhood parks have a large recreation building that can be used in both summer and winter. The recreation building usually contains a swimming pool, shower baths, club rooms, a dance floor, an auditorium, a library, and even a health center. Sometimes there are also roof gardens and day nurseries for little children.

As people learned to play on the city playgrounds, they began to realize how necessary it is for all men and women and children everywhere to play. So churches and later the government started play programs in country districts for the farmers and their families. Ball teams, women's clubs, and clubs for boys and girls were started. In rural communities there were opened recreational houses where moving pictures can be shown, and where concerts, dances, and lectures can be held. Today, thousands of boys and girls of rural communities belong to the 4-H Clubs.

About the year 1890, a new method of transportation was invented which changed the lives of most of the people of the United States. This was the automobile. With the automobile to take them, people could go to places where streetcars and trains could not carry them cheaply and easily. Then a new kind of park was started outside of the cities, called the *Country Club*. Wealthy people built many beautiful country clubs where the members could dance, play golf, polo, and tennis, and practice archery. Since golf takes a great deal of space, the public parks at first did not have golf links. Now, many cities have large public golf links, and many playgrounds are equipped for tennis and archery.

When people began to travel long distances in automobiles, the state and national governments began to give more attention to the opening of state and national parks. Today, across the country from Maine



U. S. Dept. of the Interior

In the SHENANDOAH NATIONAL PARK, Virginia. For a view in a western national park, see page 356.

to California we find national forests, game preserves, bird sanctuaries, and state and national parks. All of them are equipped with good roads and camps for travelers.

Many cities today have camps to which children can go to spend at least two weeks every summer. The time is coming, however, when cities and states and the national government will work together so that more fathers and mothers as well as children will be able to spend their vacations in national parks. Those will be happy days when the whole family packs up their play clothes to spend a whole month in a cabin in the woods!

And what fun the people have today! If you want to make a sailboat you can join the boat class at the recreation center. If you want to get out into the woods, you can join a hiking club or get into the family car with your parents and go for a long drive. If you enjoy birds, you can visit a bird sanctuary or a state park. You may help to make a puppet show, or dress a doll for a doll festival. You can swim, or dance, or enjoy moving pictures. Or, if you just want to sit and read, you can do so in a shady spot under a tree in the neighborhood park or beside the fire in the library of the recreational center. Places in which to play? You do not have to look very far for one today!

Know Your Community

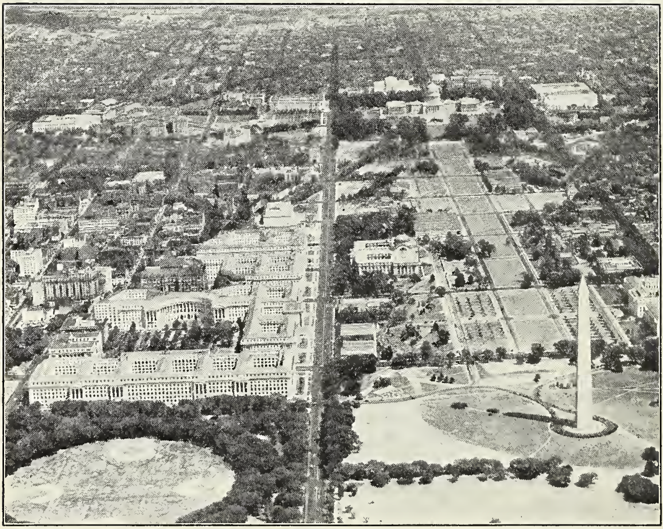
Make a list of the places for recreation there are in your community. On a map, show where all the parks, playgrounds, ball fields, and theaters are located.

Make a Plan

Make a plan or map of the kind of playground you would like to have. Would you have a ball field on the playground? A tennis court? A swimming pool? Is there any place in your community where your playground could be?

15

City Planning



Aerial Explorations, Inc.

PART OF WASHINGTON, D. C. The large buildings are the Capitol (with the highest dome) and office buildings of the national government.

When George Washington was President of the United States, he was very much interested in building a city for the nation's capital. The place which he selected on the bank of the Potomac River was a spot where Washington had camped in his boyhood, and he was very fond of it. When the site was decided upon, a prize was offered for the best plan for the new city. Many people competed for the prize, and a Frenchman, Major L'Enfant (län-fän'), won it.

With the help of President Washington, L'Enfant started at once to carry out his plan. The city grew very slowly at first, but as it grew, it continued to follow the plan. Today it is one of the most beautiful capital cities of the world. Even now, as new buildings are added to the city to meet all the needs of our day, they continue to fit into the plan made about one hundred fifty years ago. Washington and L'Enfant, the city's planners, planned not only for 1795 but for the future as well.

What is true about the plan of the city of Washington cannot be said for all the cities of the United States. You read in the first stories of this unit how some cities grew up during the machine age. Some of them, such as Gary, Indiana (pages 383–386), or Mariemont, Ohio (page 464), were new cities and were carefully planned. But most of them had been towns or small cities which outgrew their first plans or just grew large without a plan. Other stories in this unit have told you about the problems that the machine age brought to the cities. There were the problems of transportation, lighting, water supply, homes, places in which to play, and the problems of noise, dirt, and odors.

Many cities tried to solve their problems one at a time, but this method was not successful. For example, if a surface or elevated streetcar line was built to carry workers back and forth from their business, the cars increased the noise of the city and made a traffic problem. Or, often a section on the outskirts of a city would be divided into building lots; but after people bought the lots and put up comfortable homes, a factory might be built right next to them and spoil the quiet, clean neighborhood.

Cities slowly began to see that if they were to solve their many problems well they would have to solve them all together. But to solve them all together would be more expensive than any city could afford. They decided, however, that they could make a plan for solving all of their problems and carry it out little by little as the city could afford it. One by one the cities began to appoint city-planning boards or commissions. By 1916, many cities all over the country had such commissions or committees. These were taking the matter of city planning very seriously.

When Joseph Ellicot, a Pennsylvanian of Dutch and English stock, founded Buffalo, N. Y., he had a plan for the town. From Niagara Square, the center of the town, the streets ran out like the spokes of a part of a wheel. The streets were built for horses and wagons and people on foot. The streets were narrow, too, because so few people lived in the town that there was little traffic. But because Buffalo was located on Lake Erie and because the Erie Canal was built, the town began to be a business center and it

Buffalo Chamber of Commerce

CIVIC CENTER OF BUFFALO

started to grow. It grew so fast that it soon outgrew all of Joseph Ellicot's plans.

In 1922, the citizens of Buffalo saw many things to improve in their city, so they made a new plan. Their plan has ten points which they are carrying out well. As you read these points see if they cover all of the problems of a city in the machine age.

1. Have all the city's government buildings in one part of the city.

2. Arrange a traffic system which will avoid bad traffic problems.

3. Have different sections of the city for different things. Do not allow stores and homes and factories and apartments to be built together.

4. Remove all overhanging signs and other things which make our streets dangerous or ugly.

5. Improve the harbor so that ships can easily enter and leave. Also make it safe and clean.

6. Make easy the entry of trains into the city.

7. Build bridges over the Niagara River to help take care of the traffic problem.

8. Build enough playgrounds, make a municipal bathing beach, and make the water front beautiful.

9. Help to make beautiful county parks where the people of Buffalo may go to enjoy themselves.

10. Co-operate with little towns along the Niagara River so that the people who are needed for the factories of Buffalo can find places in which to live when the city itself becomes too crowded.

When the city of Cleveland, Ohio, was started in 1796, its founder, Moses Cleaveland, had a plan for it, but the first plan was not made for the days of factories, automobiles, and other inventions. Today Cleveland has a new plan which it is carrying out.

In the early days, an old man named Benhue Johnson, who had a wooden leg, sold water from house to house in Cleveland at a quarter for two barrels. Today, because of wise planning and the many inventions of the machine age, Cleveland has a great water system which pumps millions of gallons of good water from Lake Erie. The reservoirs distributed over the city look like parks, and the central waterworks remind one more of an old castle than a pumping station.

Cleveland, like all cities that plan, has very good zoning laws. The residence districts are well protected from factories and stores. New factories are permitted only in certain sections. The municipal buildings are grouped well near the water front. Good health centers are scattered all over the city, and a very fine medical center is centrally located. Most

Courtesy Cleveland Chamber of Commerce

MEDICAL CENTER OF CLEVELAND

of the railroads come to a central "union" station in the midst of the business and shopping zones.

The planning commission of Cleveland seemed to think of every need for the city. The city is well provided with parks and playgrounds. Every child has an opportunity to attend a good school with modern equipment. There is a library within walking distance of nearly every home. There are good colleges, a fine municipal art museum, a music hall, and beautiful theaters. Some day the water front will be improved. Already much has been done to take care of the traffic problem of this big city. Not all of the plans have been carried out yet, but when they are, the citizens of Cleveland can feel very proud of their well-planned city.

In the year 1850, Los Angeles, California, was just a small semi-Mexican village. It had only about a thousand inhabitants, whose houses were made of clay, called *adobe* (ȧ-dō′bĭ). Today, it is a city of over four hundred square miles and has a population of about one and a half million people. Los Angeles is a beautiful city. It has many parks, broad, well-kept streets, and beautiful homes. It used to be a little inland town, but by wise planning it now has a fine harbor on the Pacific Ocean. In 1913 an aqueduct (pages 433–434), which was planned a long time ago, was finished. It brings cool water to the city from the mountains 250 miles away. Los Angeles is a good example of how a wise plan will make a fine city.

© *Spence, from Ewing Galloway*

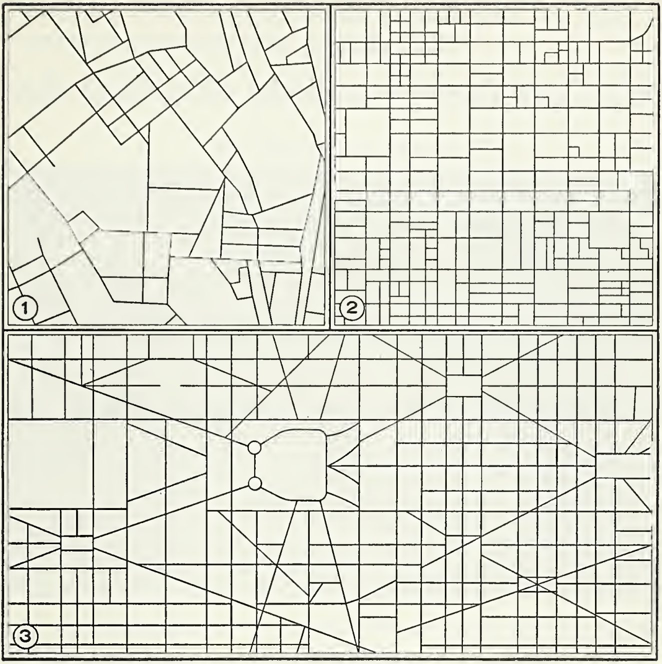
HARBOR OF LOS ANGELES

City planning has done much for many cities of the United States. Kansas City in Kansas, Houston in Texas, Cincinnati in Ohio, and St. Louis in Missouri, are examples of careful city planning. Seattle, in Washington, has been called a "city that made itself," because of the great amount of work done to improve and beautify its harbor, parks, and buildings, and because of its excellent zoning plan. Many lessons of planning can be learned from the city of Chicago, especially in its parks and its improved water front.

In 1932, when the people of the United States celebrated the two-hundredth anniversary of the birth of George Washington, they remembered how Washington helped L'Enfant carry out his plans for the capital of our country. This memory gave Mrs. Charles Sumner Bird an idea. She asked the school children of Norfolk County, Massachusetts, the county where her home is, to draw two plans of the towns in which they were living. One plan was to be like the town as it looked in 1932, the other as they should like to see it a hundred years from then. The school children must have enjoyed making plans, for on December 17, 1932, more than five hundred plans were sent to an exhibition. The plans entirely covered the walls of the gymnasium of the high-school building of Dedham (dĕd′ăm), Massachusetts. How many of these plans, do you suppose, were as wise as the plans of L'Enfant? How many do you think took care of the many problems brought to the cities by the machine age? Can you make a plan for your community?

Study Your Community

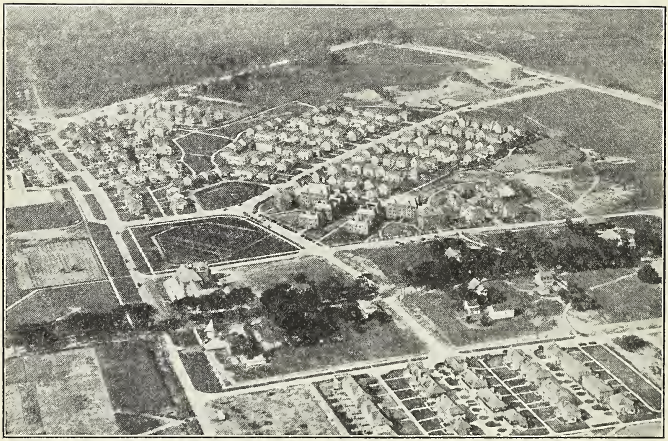
On a map of your town or city, show the sections into which you think your community should be divided.



Studying City Maps

Here are maps of small parts of three cities. One map (1) is of a very old part of Quebec in Canada. It shows crooked streets. Another (2) shows a central part of Philadelphia, first planned by William Penn. Its streets are in squares and rectangles. The third map (3) shows part of Washington as planned by L'Enfant. It has several diagonal streets besides many squares and rectangles. Of what advantage are they?

My Community and the Machine Age



RADBURN, New Jersey—a town that was recently built, after very careful planning.

Which do you think is better, a community of the machine age or a community before the age of machines began? The age of machines has given us more cities and larger cities. It has changed small communities, too. It gives us better ways of lighting streets, of getting pure water, of getting rid of garbage, and of going from place to place. But it has also brought new problems of slums, of noise and dirt and odors, of finding places in which to play, and of planning communities wisely. How has the age of machines changed your community?

An Important Word

Be able to tell the class what a *community* is.

A Testing Game

Decide whether the answer to each question should be "Yes" or "No." Write in your notebook, or on a sheet of paper, the numbers 1 to 10; and after each number write the right answer—either *Yes* or *No.*

1. Has the age of machines changed the ways of living in cities?
2. Has the age of machines changed the ways of living on farms?
3. Do the families on each street take care of the street lights there?
4. Does a community help its citizens to get good water?
5. Did the Middle Ages have a better way of disposing of garbage than we do?
6. Were trolley cars used in Washington's time?
7. Have all the changes made in communities by the age of machines been good ones?
8. Is there as much noise in Boston today as there was 200 years ago?
9. Are there more parks and playgrounds now than there used to be?
10. Should a community have a plan?

Talking Time

While finding out what our communities are doing to make themselves better places in which to live, you might like to tell one of these stories to the class, or some story you have found in other books or magazines and newspapers.

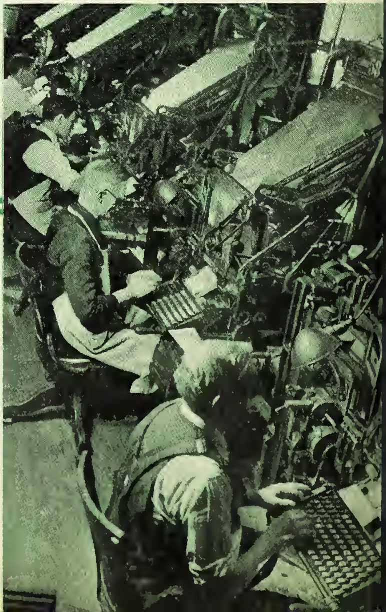
"Playing Together," Carpenter, *Ourselves and Our City*, pages 108–125.

"Planning the Community," Carpenter, *Ourselves and Our City*, pages 94–107, and Rugg and Krueger, *Communities of Men*, pages 100–115.

On pages 233–247 of Johnson's *Chicago*, you can read of the way the people of that city play.

UNIT VI

THE AGE OF MACHINES—
AND YOU



1

More Things to Use

"No, Donald," said Mrs. Fletcher firmly, "there will be no football this morning. The moving van will be here at noon, and all your things must be ready to put in it. I have packed all your clothes, but you must take care of your other things."

It was moving day for the Fletchers. For days they had been busy packing. And although Donald wanted to try out his new football that Saturday morning, he knew that what his mother said was right.

"All right, Mother," he replied. "It won't take me long to pack my things, and then I'll play ball."

"It will take longer than you think, Donald. You have more things than you realize. Get together the things in your room and the things you have in the storeroom in the basement."

Donald thought he could get all his things packed in less than an hour, but it really took him all the morning. He had some books and many copies of boys' magazines, his stamp book, and two albums of pictures taken at camp. He had a fountain pen and

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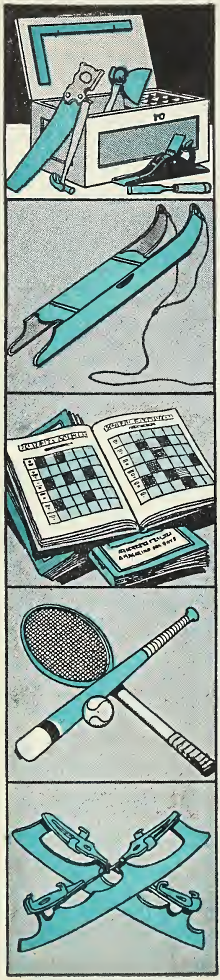
Credits: *R. I. Nesmith and Associates; Underwood, Elliott Fisher Co.*

The pictures facing this page show three kinds of recreation and two kinds of work. Have you ever seen linotype machines of a big newspaper plant, like those shown here?

a whole box of pencils and crayons and rulers, a compass, and a T-square. It had been a long time since he had used his box of paints and brushes, but he wanted to take them along, too.

From the basement he brought the tool kit his uncle had given him for Christmas. Skates, skis, baseball bat and glove, sled, construction set—when Donald had all his things together he was very much surprised to see the number of things he owned.

Like Donald, most of us have many more belongings than we realize—all the little things we use each day, or put away to use on special occasions. And you know, of course, why we have so many things. Most of them are made by machinery; they are products of the age of machines. Before many machines had been invented, most people had very few things of their own. Boys



These pictures show some of the things Donald owned, and had to pack. What other possessions do you think he had?

and girls had only one or two suits or dresses of homespun cloth. These were worn until they could be patched and mended no longer. Girls had few dolls; there were no roller skates; wagons and sleds were made by hand.

In books about colonial life you can find lists of clothes bought from England by wealthy parents for their children, but there were no ski suits, tennis shoes, bathing suits and caps, no bicycles or scooters for the little children, no scout uniforms—hardly any of the many things you have.

Because you are used to having so many different belongings, you can hardly imagine living without them. Your *standard of living,* or way of living, means your food and all the comforts and conveniences and belongings which you have and enjoy from day to day. Today, because of the age of machines, our standard of living is high. Our higher standard of living is the gift of the new age. The machines can make thousands of things quickly and cheaply so that nearly everybody can buy them. Almost everything that Donald packed and almost everything that you own was made by some machine. Even the few handmade articles which you may own are usually made of materials turned out by machines.

You who have read the stories in this book know that the machine age brought many new conveniences and problems to Donald's city. The machine age also brought Donald all the things he owned. In the old days of hand labor it took so long to make things that only very wealthy parents could give their children half as many clothes, books, and playthings as nearly all children have today. Even the wealthy children did not have so many different things as you have.

Besides your clothes and other belongings, the machine age has given you a higher standard of living at school. You are used to comfortable seats and desks slanting conveniently for writing, with inkwells and a groove to hold your pen or pencil. You have different kinds of paper for writing, drawing, and painting. You have colored crayons to color your maps and posters. How easy it is to write on the smooth blackboard and to have the chalk and felt eraser handy on the chalk tray! How pleasant the pictures make the schoolroom look! In one corner is the globe; in another, the dictionary stand. How many interesting books there are in the schoolroom library! What fine places in which to play are your gymnasium and playground with all their equipment and lockers! All these things are made by the new machines; we say they are "machine-made." They are a part of your higher standard of living.

You also enjoy a high standard of living in the many interesting things you learn in your school. You learn about the earth and the stars, about plants, animals, and people. You learn about the ways of living in different countries. In many schools the children have lessons in drawing, music, cooking, and sewing. The new schoolroom equipment and books of our machine age have brought new knowledge to your standard of living.

Three Lists

Before you leave school today, make a list of the articles in your schoolroom. Then ask your father and mother for a list of things they had in their schoolrooms when they were your age. If possible, ask your grandparents or people about their age to list the articles they had in their schoolrooms. Copy the lists side by side in your notebook. You may head the lists:

Things in My Grandfather's Schoolroom	*Things in My Father's Schoolroom*	*Things in My Schoolroom*

What do the lists tell you about the age of machines?

Talking Time

Find out from stories in library books what kinds of toys and play equipment children of colonial times had. Compare their toys and equipment with yours.

How many of your possessions were made by machines?

2

Home Conveniences

"Oh, dear," wailed Enid, "the sink is stopped up."

"Well, then," said her grandmother, "we shall have to carry out the dishwater as we used to do when I was a girl."

"Didn't you have a sink in your kitchen when you were a girl?" asked Enid in surprise.

"No," laughed her grandmother.

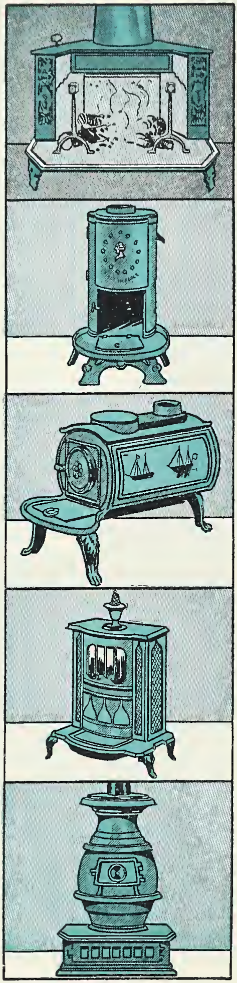
"Then I suppose you didn't have water faucets and bathrooms either, did you?" asked Enid in still greater surprise.

"No," laughed her grandmother again. "You would think that we had very few comforts in our home if you could have visited it. My grandmother thought we lived very comfortably, though, compared with the way she had lived when she was a girl."

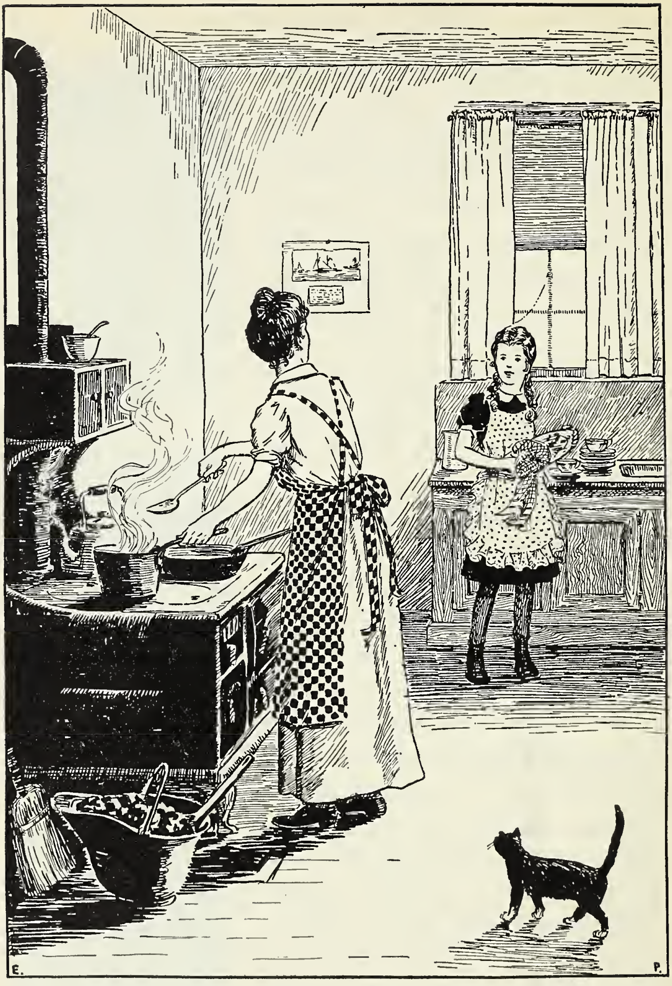
"What did you have, grandmother, that your grandmother did not have?" asked Enid.

"When my grandmother was a girl, people still depended on the fireplace for cooking food and heating the house," was the reply. "They had no stoves. Most people had to depend on candles and the fireplace to light their homes after dark. They had no good lamps, even. When I was a little girl I never grew tired of hearing my grandmother tell about the very first matches she saw. One evening her father came home from a trip to town, and with him he had a bottle of queer-smelling, thick liquid. He dipped a long splinter of wood into the bottle, gave it a quick, hard rub, and he had struck a light! It was then that flints and tinder boxes were put away in the attic and people no longer had to worry if the fire went out during the night.

"When I was a girl," continued Enid's grandmother, "we had a big black iron cookstove in which we burned wood and coal for cooking. In some of the rooms of our house, we had other iron stoves. These stoves gave off a more even heat than did the fireplace, but you would not have thought them very convenient. These big, black stoves were not so attractive and cozy as the fireplaces of my grandmother's



These pictures show kinds of stoves which have been used to heat rooms. Compare them with the way your home is heated.



Here you see a big, black cookstove. How does it compare with the stove shown on page 509?

girlhood, but we thought they were a great improvement over the fireplaces."

Grandmother smiled as she thought of the stoves of her girlhood. "Of course, we could not afford to have stoves in all the rooms of the house," she said. "How well I remember the cold bedrooms in my home when the temperature outside was zero or below, and the water in the pitcher froze during the night!"

"But didn't people have furnaces?" asked Enid.

"I knew of no homes in my town that had furnaces when I was a girl," answered her grandmother. "Even when your mother was born, your grandfather and I did not have a furnace in our home. You can imagine how pleasant our home seemed to us when we had a furnace put into it, and heat came through pipes and radiators to all the rooms of the house."

"What a lot of changes you must have seen in the ways of living right in your home!" exclaimed Enid, as she rinsed the glasses she had just finished washing.

As Enid and her grandmother finished the dishwashing, they talked of other conveniences that the age of machines has brought to our homes. In millions of homes in our country gas stoves or electric stoves have taken the place of the cookstoves which burned wood and coal. In some parts of the country where there is as yet no electricity or gas, oil stoves and gasoline stoves make it easier and quicker for the housewife to do her cooking. Of course, there are still many homes that depend on the coal-burning or wood-burning cookstove. In some homes it is used along with gas or electric or oil stoves for cooking that takes a long time.

In the last fifty years in millions of homes electric lights have taken the place of oil lamps. For people who still use oil, there are now kerosene lamps that give very good light.

At the same time that millions of families have stopped tending the kitchen fire and trimming oil wicks and cleaning lamp chimneys, they have also stopped pumping water and carrying it into the house for cooking, cleaning, and washing. Pipes now carry water into millions of homes. Other pipes carry away the water that has been used. In these homes kitchen sinks and bathtubs make life more comfortable than it used to be.

Enid's grandmother was amused when she told of the first little electric power plant that was built in the town where she lived. People who could afford it soon had their houses wired and enjoyed the convenience of electric lights. Electricity was not always such a convenience at first, however, for often something went wrong at the powerhouse and the current was shut off. Then people had to get out candles and the old oil lamps again. Today most communities get their electricity from large power plants, one of which may supply many communities. Once in a great while a flood or some other great

Edison Electric Co.

An Electrical Stove, in one corner of a modern kitchen.

disaster might stop the current; but we can almost always depend on a steady supply of electricity.

People soon found many ways of using electricity to make their homes convenient. The first convenience most families bought after electric lights was usually an electric iron. The electric iron made ironing easier and quicker than it had been with the old flatirons heated on the stove. After 1906 more and more people began to buy electric irons and washers and vacuum cleaners to help with the heaviest and hardest work of housekeeping.

In the 1920's and 1930's factories were making still more electrical conveniences for the home. Many families that could afford to do so bought electric refrigerators. Electric sewing machines, electric toasters, electric mixing machines are other conveniences that factories make by the thousands today. For the families in the country who are not near an electric power line or who cannot afford to buy a little electric plant of their own, there are washing machines run by gasoline, and irons heated by gasoline to help with the work of the home. It may be that the day will come when most of the homes in our country will be able to use electricity to make life pleasanter and more convenient.

As Enid dried the last dish and picked up the pan to carry out the water, she said, "When I turn a faucet, or pour water down a drain, or press an electric-light button, I never stop to think of the conveniences we have in our home."

"We have all these conveniences," said her grandmother, "because men have learned to make thousands of things quickly and cheaply in factories. I have seen how the age of machines has raised the standard of living in our homes," she added, as she went to the telephone to call the plumber.

Houses Then and Now

Make models of two homes. One would be a colonial house, the other a modern house. To carry out this plan, take the following steps:

1. Choose two committees to plan the houses.
2. Make the houses.
3. Make the furniture.
4. Make curtains, rugs, bedding, and other such things.
5. Dress dolls to represent the people living in the houses.

Perhaps the boys could make the houses and furniture in their manual training class. The girls could make the other furnishings and dress the dolls.

Be sure the two houses show that the age of machines has brought many new home conveniences.

Making a List at Home

Make a list of home conveniences brought by the age of machines. Include, first, those that are mentioned in this story. Then look around your home to see if you can add some other conveniences to the list.

Talking Time

In building a home today, what kinds of workmen are needed who did not help build houses in colonial times?

3

Many—But All Alike!

Down fell the coffeepot to the floor! Smash went the glass in the coffeepot lid! Rattle went the rim as it rolled under the kitchen sink!

"Oh, dear," sighed Nancy's mother. "That means I must make another trip to the store, and I'm so busy today."

"Do you have to get a whole new coffeepot, Mother?" asked Nancy.

"Oh, no," said Mother. "No, indeed, not in this age of machines. Factories make percolator tops by the thousands. They are sold separately from the coffeepots, but I don't want to take time right now to go after one. I ought always to keep an extra top on hand."

"Let me get it, Mother," said Nancy. "I'll have time to go to the store before going to school. Tell me where to go and what to ask for."

"That will be a help, Nancy," said Mother. "Here is the money. Go either to the hardware store or to the five-and-ten-cent store, and ask for a percolator top."

"Shouldn't I take the coffeepot with me?" asked Nancy as she put on her coat. "The new top may not fit."

Photo by A. E. Gaynor, from Nesmith and Associates

In this large factory thousands of pairs of stockings are made, all just alike.

"I think it will," answered Mother. "Today most percolator tops are made just alike. If one fits, the others will. That's one thing we have to be grateful to machines for. They make thousands of things just exactly like one another."

"May I get any color I like, Mother?" asked Nancy.

Her mother smiled. "You may get any color you can find," she said, "but I'm afraid you'll not have much choice. The manufacturers seem to think we want only white tops or green tops. If you want a different color, you'll have to go to a more expensive store where special things are sold to people who can afford to be different. All the families on this street, I know, have either white or green glass in their coffeepots. That's one disadvantage of the machine age: people have to be alike in many ways whether they want to be or not."

As Nancy hurried down the street she thought about her mother's words. "Of course," she said to herself, "it's nice to have things cheap and easy to get, as machines have made them. And it's nice to have things enough alike so that new parts will fit old ones. Then you don't need to throw away a whole coffeepot just because a part of the lid is broken. But it's rather too bad that everything has to be so much alike. I should like to be a little different from my neighbors."

Nancy reached the five-and-ten-cent store and hurried inside. There were all the counters, just about as she had seen them again and again—the ribbon counter and the candy counter, the counters for toilet goods and toys, for stationery, and for pots and pans. Nancy had never thought of it before, but now she knew that ever since she could remember these counters had been piled with much the same kinds of goods. And more than that, a few blocks farther off was another store that looked just like this one; and beyond that was another and yet another.

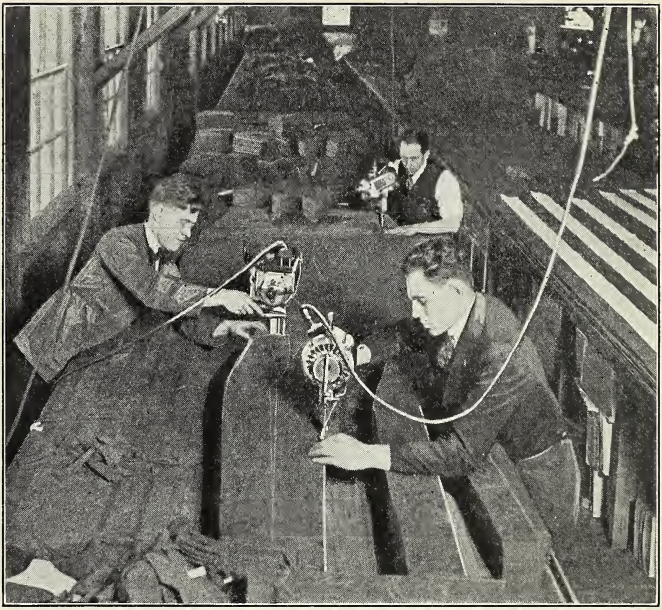
"Why," thought Nancy to herself, "I wonder how many other counters in the United States there are just like this one. Everywhere in the whole country people must be buying either white or green glass tops for their coffeepots. Perhaps this very minute there are dozens of persons going to the stores. I wonder how many of them will pick the green top as I'm going to!"

Quickly Nancy made her purchase and took it home. Then she hurried on to school. There was a merry tune on her lips as she entered the schoolyard. She looked as gay as she felt, for she was wearing her new red dress. She thought she had never had such a pretty dress as this one which her mother had bought her. When she entered the schoolroom, she stopped suddenly in surprise. There stood Hope with a new dress exactly like hers!

"Why, Hope," cried Nancy, "you have on a new dress just like mine. Our mothers must have bought them at the same place."

"What lovely dresses they are," said Miss Abbott as she greeted the girls. "I am glad you both happened to wear them today, because now you can help the class with today's lesson. Before the age of machines it would have been almost impossible for two girls to have had dresses just alike. Even if their mothers tried to dye the yarn the same color and weave it in the same pattern and then make the dresses the same way, they would probably be at least a little different. But as nearly as I can see, Nancy's and Hope's dresses are exactly alike. Aren't they, really?"

"I am afraid they are," admitted Nancy. "I was pleased with my dress because it was different, and



These tailors, using electric cutting machines, can cut out the cloth for many garments at one time. Notice how very many thicknesses of cloth are on the tables.

now I find that it is not different at all. I'm not at all sure I like some of the things the age of machines has done for us."

"Why, Nancy," interrupted several boys and girls, "you don't mean that!"

"Suppose we think right now," said Miss Abbott, "and see whether or not we agree with Nancy. In the last few days we have learned about many things that the age of machines has done for you and me. See if you can tell me some of them."

"Well, in the first place, Miss Abbott," volunteered Lois, "Nancy and Hope probably couldn't have afforded to buy such pretty dresses before machines were invented to make them cheaply."

"Not many of us could afford the clothes we now wear if we were living before the age of machines," added Dick.

"We couldn't have so many or such good kinds of food to eat, either," said Carl.

"Or automobiles, or busses, or trains to ride in," spoke up Enid.

"Or many of the new comforts and conveniences in our homes," said Harvey.

"Yes, the age of machines has raised our standard of living," said Miss Abbott. "Some things that we think are necessities of life today were luxuries for even the wealthy a hundred years ago. Many of the comforts we feel we cannot get along without, our grandparents never even heard of when they were boys and girls in school."

"Of course," said Franklin thoughtfully, "many of the things I have at my house are just like, or almost like, many of the comforts that Dick has at his house. That is because they are made in great quantities by machines. But I shouldn't want to give up my comforts just because they are not different from Dick's or any one else's."

"I shouldn't want to give up my bicycle, even though it is hard to tell it from dozens of others!" exclaimed Tom.

"That's true of almost everything we have, Miss Abbott," said Lois.

Miss Abbott nodded and asked, "How do you feel about the age of machines now, Nancy?"

"Oh, I understand, Miss Abbott, and I am glad it has given all of us so many things to use. I know it has given us greater comforts and conveniences than were ever possible before, but I still wish they weren't all so much alike," said Nancy, smiling, as she glanced at Hope's new dress and then at her own.

Talking at the Dinner Table

Perhaps your father and mother would enjoy talking about the things they use every day which are just like their neighbors', and about the things they do every day which are different from what their neighbors do. As you talk together try to answer this question: "In the age of machines must we all be alike?"

The Bulletin Board

On the Bulletin Board place pictures of some of the things that are part of your standard of living today.

4

What the Age of Machines Gives Us

The age of machines gives each of us many things. It gives us clothes and books. Our skates and baseballs and playground equipment are made by machines. Machines make more things than can be made by hand. Today all of us have more comforts to use than did our ancestors who lived before the age of machines. Because we use the things made by machines, we have many things like our neighbors'.

Can you make a list of all the things you have used today which were made by machines? Do you think that the age of machines helps very much to make your ways of living?

Talking Time

Why does the age of machines help us to have more things to use?

What is a *standard of living?*

Why do we have many things just alike in this age of machines?

Reading Time

Look ahead to pages 573-574 for books to read that tell about some of the things the age of machines gives us.

5

From Apprentices to Schoolboys

Long ago, about the year 1400 A.D., there lived in London, England, a boy named Will. On one spring morning Will stood outside his home saying good-by to his mother and father and brothers and sisters. He was leaving them for a long time. He was going to stay with Master Thomas, a goldsmith.

Will felt both sad and happy about going. Although he was sorry to leave his home, he was glad to think he was going to work for Master Thomas, a skilled goldsmith in London. All his life he had looked forward to the time when he might learn the difficult trade of the goldsmith. Will's father, grandfather, and great-grandfather were goldsmiths, too. At that time most boys followed the same trade as their fathers. Will had long known that when he was old enough, he would become a goldsmith.

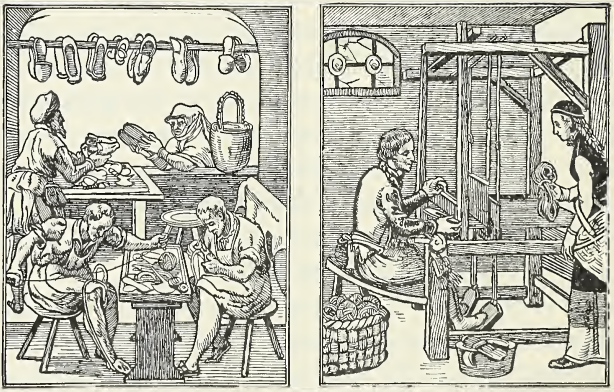
Will became the apprentice of Master Thomas. In those days when a boy learned a trade, he first became the apprentice of some person who was already a "master" of the trade. As an apprentice Will lived in the house of Master Thomas and worked hard in his shop. At first he took care of the tools. Then he was allowed to melt the gold, and shape it into jewelry and choice boxes. All this time he received nothing for his labor except his board and clothes. Gradually Will himself learned to make beautiful things of gold. Finally Master Thomas said to him, "Now your seven years are up. I have taught you what I know about working in gold. You may now be a journeyman."

As a journeyman, Will could travel about and practice his craft for pay, although, for a time at least, he still had to work under the guidance of some master. He longed for the day when he would become a master himself and belong to the goldsmiths' guild or society. At last that day came. Will had made a specially fine ring of gold. It was so beautiful and so cleverly made that when the master workmen saw his masterpiece they decided that he was skilled enough to become a master himself. When he became a master he was admitted to the goldsmiths' guild. Now he could have a shop of his own and even teach other apprentices the trade. He had earned the proud name, "Master Will, the Goldsmith."

If you had been a boy in London when Will was an apprentice, and wanted to learn a trade, you, too, would have had to become an apprentice to a master workman. That is, you would have lived in his house with him, worked for him, and learned his craft from him. Perhaps you would have become a tailor, a potter, a shoemaker, a weaver, a dyer, a carpenter, or a mason. But whatever trade you chose, you would have had to serve from three to seven years without pay while you learned to do the work.

Hatter

Goldsmith



Shoemaker

Weaver

Crafts of the Middle Ages; from pictures of the sixteenth century. The craftsmen and apprentices in each guild worked only with hand tools.

Just think how different our lives are today! Do you think you would have liked to live in Will's time? If you had lived then, and your father was a carpenter, you would probably have become a carpenter too. Perhaps you are not good at handling tools and do not want to become a carpenter when you grow up. Today you have a better chance to make your own choice of what you wish to do to earn your living. Perhaps you may choose to become a bookkeeper, a doctor, a machine operator, an engineer, or whatever else you are best fitted for.

Remember that when Will was a boy there were no machines. When machines were invented many new jobs were invented, too. You are fortunate today to have a greater choice of jobs than the boys and girls of colonial times. There are so many jobs to choose from now that you must think carefully of what you wish to do. If you select a job for which you are well fitted you will be happy in your work.

It is not always easy to get just the job you want. You might train to become an electrician and then find you had to go to work in a shoe factory. After Will the Goldsmith had learned his trade he was pretty sure of finding work in that trade.

You may be wondering how long Will the Goldsmith went to school, since he went to work for the master craftsman when he was still young. Will did not go to a school such as yours. The home of the master craftsman was his only school. None of the boys and girls of the Middle Ages went to the sort of schools you know. The Church had schools for some boys who were to become priests or government officials. Most children had no chance to attend school at all. Many grew up to do only the work of the farms and households. Others, like Will the Goldsmith, were apprenticed to masters until they learned a trade and could join a guild. They spent all their time practicing the work they were to do when they became masters.

You may ask, "What about the girls? Did they have a chance to train for jobs before the machine age?" Most of the girls and women of that time worked in the homes. You remember that many things that are now done in factories were done in the home then. You may be sure that even very little girls were kept busy helping with the numerous tasks of the household. Probably very few women learned a craft by which they could earn their living as did the boys who were apprentices to master craftsmen.

Today in the machine age, instead of becoming apprentices or working all day in the home, both boys and girls almost everywhere go to school. Machines have made it possible for you to have time to learn much more than how to do your job in the world. See if you can make a list of some of the interesting things you learn in school that Master Will never had a chance to learn. Today we think that just learning to do your job well is not enough to train boys and girls to live happy and useful lives.

The Nation's Schools

These pupils in a school in Illinois are learning to use the typewriter. How will their ability to use it be of value in this age of machines?

Education for life in the machine age is learning a great many things. It is learning to read, and write, and think, as well as to make things and tend machines. Schools of today try to teach people much about the fascinating world we live in. Our schools try to teach what the machine age is, and what its advantages and disadvantages are. Later on, in trade schools, in high schools, in colleges and in universities you can learn how to become workers in our world —how to work as secretaries or machinists, or printers, or mechanics, or doctors, or lawyers, or teachers, or workers in some other worth-while task in the machine age. Schools today have taken the place that training by apprenticeship had for many, many centuries. Schools try to teach us not only how to do our jobs well but also how to live well and intelligently in our world.

Searching for Facts

Paul Revere, the man in colonial days who rode from Boston to Concord to warn the farmers that the British were coming, was a silversmith. In an encyclopedia or some other book try to find out how and where he learned his trade.

According to the laws of your state how long must you go to school?

Using the Dictionary

Find these words in your dictionary and write their meanings in your notebook:

apprentice
journeyman
guild
craftsman
mechanic
machinist

Writing Time

Write a paragraph which explains this sentence: "Education for life in the machine age is learning a great many things."

6

New Kinds of Jobs

"I'm going to be a mechanic when I'm a man," said Harvey.

"I want to work in an electrical laboratory," said Franklin.

"I want to be an aviator," said Dick.

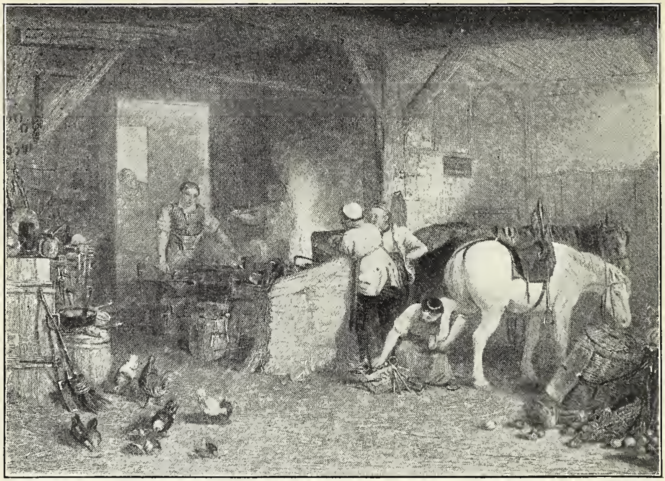
The members of Miss Abbott's class were talking about the things they would like to do when they were grown men and women. Several of the boys agreed with Dick that they wanted to be aviators. Three of the boys wanted to work in an automobile factory. Carl wanted to be a newspaper reporter, and Tom wanted to be a radio announcer.

Enid wanted to work on a newspaper, too. Several of the girls wanted to become nurses and others wanted to work as stenographers or as teachers.

Miss Abbott listened to their talk for a time and then she said, "Almost every one of you wants to do a kind of work that has developed since the age of machines began."

"That's right," Franklin agreed. "Before the age of machines there weren't mechanics and aviators and stenographers, were there?"

"No, indeed," answered Miss Abbott. "Before the age of machines, most people worked as farmers or



Fairbanks

AN EARLY BLACKSMITH'S SHOP

shopkeepers or craftsmen, such as Shoemaker Ethan and Weaver John. Just think how many more kinds of jobs there are today than there were then! And some kinds of jobs are no longer needed and have almost disappeared. In your great-grandfather's day many boys wanted to be blacksmiths. I suppose some of you don't know what a blacksmith is!"

"Oh, I do," said Carl. "I remember the poem of Longfellow's which begins:

Under the spreading chestnut tree
The village smithy stands. . . .

A blacksmith made iron shoes and put them on horses. He mended plows and other iron tools."

"Yes," said Miss Abbott, "and there are very few blacksmiths left in the United States. Their places have been taken by garage men, mechanics, and men who run filling stations."

"And the old cobbler who made shoes to order isn't found very often these days," said Lois.

"In the place of the old-fashioned cobbler is the shoe factory, with its hundreds of workers who tend machines," said Nancy.

"All these changes in the kinds of jobs men work at show what work you may do when you are grown," said Miss Abbott. "Today there are many, many kinds of jobs not known before the machine age, and most of you will earn your living doing those jobs. There are jobs in mining, farming, factory work, and office work, jobs as mechanics, as business men or women, as doctors, dentists, lawyers, and teachers. All of their work must be done if our ways of living are to be continued. What kind of work would you like to do? What kind will you be able to do best?"

* * * *

Here is a census list of some of the most important kinds of work in the United States. Can you tell what some of the workers in each group do?

1. Agriculture
2. Forestry and fishing
3. Extraction of minerals
4. Manufacturing and mechanical industries
5. Transportation
6. Trade
7. Public service
8. Professional service
9. Domestic and personal service
10. Clerical occupations

A Chart about Jobs

Kind of Job	*Where it was done before the age of machines*	*By whom it was done before the age of machines*	*Where it is done today*	*By whom it is done today*
1. Nursing				
2. Weaving				
3. Shoemaking				
4. Making books				
5. Making furniture				
6. Making stockings				
7. Making cheese				

Copy this chart in your notebook—making the blank spaces larger—and fill in the blank spaces. What does it show you about changes in jobs that have come with the age of machines?

Finding Out

Perhaps you have decided upon the kind of work you would like to do some day to earn your living. If you have, find out these facts about it:

1. Where can you learn to do the work?
2. How long will it take to learn to do it?
3. About how much money will it cost to learn?
4. About how many people are there who are already doing that kind of work?
5. About how much money would you earn?

When you have found out these facts, put them into a talk to give before your class. Remember to tell:

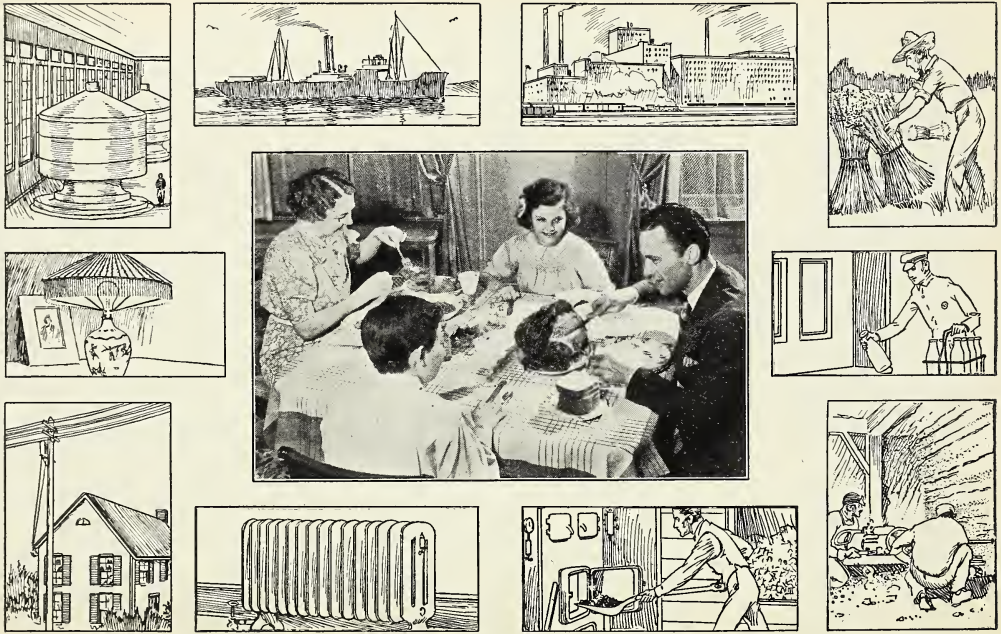
1. The kind of work you want to do.
2. Why you want to do it.
3. The facts you have found out about it.

Test

Decide whether each of the numbered statements below is true or false. In your notebook or on a sheet of paper write the numbers 1 to 10, and after each number write *True* if the statement of that number is true, or *False* if it is not true.

Is It True that

1. Having the things we have is often called "standard of living"?
2. The age of machines has nothing to do with the number of things we have today?
3. Machines have made our homes just like homes of colonial times?
4. Machines make thousands of things just alike?
5. Having things just alike does not make people just alike?
6. Before the age of machines people could afford to have many more comforts than we have today?
7. Machines help to make our ways of living?
8. Schools today take the place that training by apprenticeship had for many centuries?
9. There are many more kinds of jobs today than before the age of machines?
10. Guilds train many workers today to run machines?



How do the things shown in the border pictures help this family's standard of living?

7

With Those Who Work

When the heat comes on in your radiator on cold winter mornings, is it steam heat from a coal-burning furnace? If so, probably, downstairs in the cellar someone has been shoveling coal into the furnace to feed the fire. And while the shoveler puts on the coal to send more heat through the pipes to you, men are down in damp, dark tunnels underground, digging dirty black coal out of the earth to keep your fire going. Rocks sometimes fall on miners, gas sometimes poisons them, and fire and explosion sometimes kill them. But many men are ready to keep on digging, because they must earn money to buy the things they need.

When you sit down at the breakfast table and pour cream and sugar on your cereal, do you ever think of the milkman who drove about the city before daybreak, while you were still asleep, to bring the fresh milk to your door? Farmers worked under the hot sun for hours and days and weeks to grow and harvest the grain of which your cereal is made. Men toiled on sugar plantations and in the hot boiler rooms of ships that brought the sugar from the places that grow sugar cane; or other men worked as hard in the beet-sugar factories.

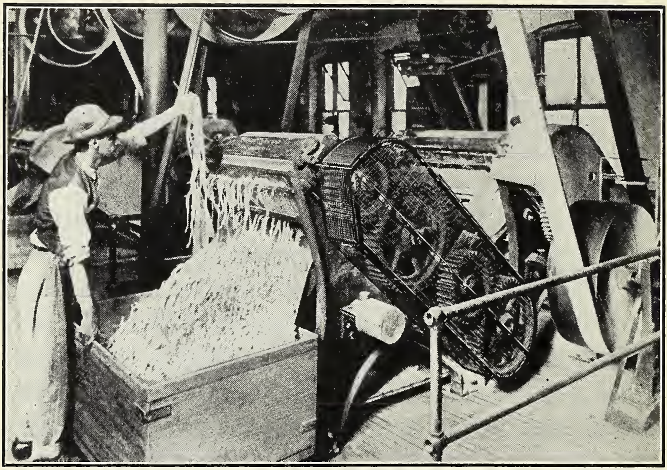
To make possible our ways of living today, millions of people are at work while you read this story. Men are working in the cabs of locomotives as they rush across the countryside. Thousands of clerks wait on customers in the stores and shops of the country. Thousands of stenographers and other office workers are writing letters and filing papers. Perhaps some of the letters are about the price of the coal in your cellar or the milk left at your door. While you are sitting in a theater enjoying the picture or the play, some man or woman is selling tickets in the office outside; ushers are showing people to their seats; and operators in the little, high room at the back of the theater are making the pictures go, or actors are playing their parts on the stage. You can reach your friends over the telephone because somewhere a girl is sitting at a switchboard ready to make connections of the wires for you.

Some of the human workers in the age of machines get very tired at their jobs. Digging ditches, cleaning sewers, mining coal—these are not easy tasks. Even with all the sources of power that man has to help him, the muscles of millions of men and women still ache when their day's work is done. And not only is some of the work hard, but some of it is very tiresome. It is no fun to do just one thing over and over again all day long. How should you like to work in a factory where all you did, hour after hour and day after day, was to fasten fenders on automobiles as they came past you in endless procession? Or to paste labels on cans? Or to roll little triangles of paper into pointed rolls for dentists to use? People get tired of their work sometimes. But the work has to be done, and doing it is the modern way in which many people earn a living.

There are other things about working and living in the machine age which we should think about. We are in danger from accidents. People who work in the age of machines suffer more injuries than those who worked in the age of hand tools. When a tunnel was being built under the Hudson River an accident occurred, and twenty men were drowned. Thousands of men have been hurt or killed in putting up the electric-power lines and building the bridges and skyscrapers and railroads that we use today. There are accidents because of automobiles; each year for many years in the United States more and more people have been hurt or killed by careless driving.

Inside many factories the conditions for work are not always good. Dust gets into the lungs of some workers. Poor lighting makes them strain their eyes. Dampness and bad air and poor sanitation in some factories cause disease and suffering for those who work there. Greasy floors make the workers slip, perhaps falling against machines that have no guard rails around them.

Other and newer factories and mills, however, are much better working places. In them the light and



Ewing Galloway

SAFETY DEVICES beside a machine in a soap factory.

air are good. Safety devices have been used on the machines, so that workers are not so likely to be injured. Floors are kept clean, and washrooms and rest rooms are provided.

Years ago, when a man was injured while at work, he had to pay all his own doctor's bills. Now many factories and mills have doctors and nurses and even hospitals of their own to care for the injured. Laws have been passed in most of the states of our country requiring factory owners to pay money to people who are injured. These *workmen's compensation laws,* as they are called, have been a great help to the workers in recent years.

Another thing about working in the machine age is the fact that a worker is often not sure whether he can get a job and how long he can keep it when he does get it. In the years between 1919 and 1929 in the United States almost every boy and girl who graduated from high school and who wanted a job found one. But in 1929 there began a *depression* or period of hard times. Many factories were not able to sell the things they made, so that some of them had to be closed. Several million workers had to be "laid off" because there was no work for them to do. Boys and girls graduating from high school in 1929–1936 had a very hard time finding any jobs at all. The number of people "out of work" was very, very large. Without a job one cannot get money to buy the things one needs.

All these things—(1) the difficulty of some kinds of work, (2) the tiresomeness of doing some things over and over again, (3) the dangers from accidents and poor working conditions, and (4) the danger of being "out of a job" and not able to earn a living—are things we ought to think about very carefully. Those who work know that serious problems came with the age of machines.

A Class Visit

Ask your teacher to take you to visit a factory in your community. While you are there keep your eyes open and see if you can answer these questions when you return to school:

Was the factory well lighted?

How was the factory ventilated?

Were the staircases safe?

Were there fire escapes?

Were there any fire hazards in the building?

Did the machines have guards which protected the workers?

Did the workers have tiresome jobs?

How many different kinds of jobs did you count?

Can You Tell?

Does your state have workmen's compensation laws?

Does your state require factories to make working conditions safe?

What does the government do to help young people get jobs?

How many people in our country are out of work?

The Bulletin Board

On the Bulletin Board place pictures and clippings that show ways in which workers are being protected in factories. Can you find clippings which tell how people and the government are trying to find ways of keeping as many workers employed as possible?

8

Money, a Handy Tool

After you have finished school and go to work in this age of machines, you will receive money in exchange for your services. With this money you will buy the things you need to make your lives comfortable and happy. Probably right now, some of you sell newspapers after school hours, or run errands, or do other jobs to earn money to buy the things you want. Most of you see money used or use it yourselves almost every day in your lives. We have become so familiar with convenient pennies, nickels, dimes, and bills, that often we forget how difficult it would be if suddenly we had to trade without them. Almost everything we use in the age of machines is bought and paid for with money. Without money our ways of living today would be impossible. Yet men have not always had this valuable tool to help them in their trading.

You remember that when primitive men traded they merely swapped or bartered one article for another. In the very early days of Egypt, Babylonia, Greece, and Rome, each of these countries had no money as we know it. The people of ancient nations exchanged the goods of which they had plenty for the goods of which they had few or none. It was not until about

700 B.C. that the Greeks got—from one of the nations in western Asia—the idea of making metal coins, chiefly of copper, silver, and gold. Think what a great improvement this coined money was over the old custom of bartering. For it a farmer could more easily sell his sheep, and with it he could buy just what he needed for himself and his family.

ROMAN COINS

The Romans learned to use coined money from the Greeks. At first any one who wanted to could hammer out the pieces of money he used. This caused cheating. Dishonest people mixed cheaper metal with the copper, silver, and gold, and used their coins as if they were made of pure copper, silver, and gold. Merchants would not take these coins until they had weighed and tested them to find how much they were really worth. Of course this made trading difficult.

At last the great Roman government, which ruled most of the ancient civilized world, took charge of making money so that it would always be good. The Roman money thus made was worth its full value anywhere in the Roman world. The government made round flat coins. On them it stamped the head of the emperor and designs to make it hard for counterfeiters to copy them. It became a crime then just as it is now for anyone to coin money except the government. Counterfeiters are criminals who try to manufacture false money which can be passed as real money. Counterfeit money often looks like real money but is not good. Did you ever wonder why coins are made with little grooves around the edges? This is so people cannot shave off gold or silver from the coin without its being noticed.

When Rome was conquered by the barbarians there was no longer a strong government to make money. Again dishonest people mixed cheaper metal with the gold and silver and spoiled the good Roman money. No one wanted to take it in exchange for goods. Trade almost stopped and the people of western Europe returned to slow, primitive bartering.

After many years some of the nations of Europe grew strong enough to coin their own money. The great French ruler Charlemagne (shär′lē̇-mân) made a pound of silver the money standard in most of Europe. That is, money was figured in pounds just as today in the United States money is figured in dollars and parts of a dollar. In England the pound sterling was at first a whole pound of silver. Later the English put less and less silver into their pound until at one time it weighed only about an eighth of an actual pound. The English pound has in most years been worth nearly five dollars in our money.

Silver and gold money weighed so much that it was clumsy to carry large sums about. Often merchants of the Middle Ages had to take a servant or a donkey along with them just to carry their heavy bags of silver. If you were fortunate enough to have $100, think how inconvenient it would be to carry 100 silver dollars around in your pocket. We do not have to do that, however, because today we have convenient paper money to use.

The Chinese gave us the idea of paper money. A piece of paper money, in normal times, is simply a promise to pay you in gold or silver the amount printed on the bill. It is a promise made by the government, or by a bank under the control of the government. The government may keep the heavy gold or silver in the treasury and give you a small handy bill to take its place.

The American colonies which later became the United States were, as you know, British colonies. Yet today in the United States we do not use the British system of money with its shillings and pounds. Our system of money was borrowed from the Spanish. You may wonder why this is so. England did not have enough shillings and pounds to spare for the American colonists. Spain had grown rich. She owned Mexico, and in Mexico there were silver mines. The Spanish made this silver into thalers or dollars.

In the sixteenth and seventeenth centuries the names *thaler* and *dollar* were given to many coins in Europe.

In Spain the thaler was called a *peso* (pā′sō). The peso was also called a *piece of eight,* or eight reals. A real is a bit, or 12½ cents. Today there are still eight bits in a dollar. There were plenty of Spanish dollars to be had in America, so the colonists were glad to use them in place of barter. Also, the Spanish money was easier to use than the English money. The Spanish system of money was one of the easiest with which to figure prices and debts. The English system was much more difficult.

After the Revolutionary War the United States was ready to coin its own money in government mints, and print its own paper money. At that time Alexander Hamilton was Secretary of the Treasury. He was born and brought up in the West Indies, where he had learned to use Spanish money. He persuaded the United States to choose the easy Spanish system for our money. This wise choice has saved the business people of the United States, and you, much figuring that would have been necessary had we chosen the English system of money.

Today we have a good system of money to use. The government of the United States coins and prints our money. Because the government manages money well, people are glad to accept it in exchange for goods.

Money is one of the handy tools of the machine age. Without it our ways of living today would not be possible. Imagine how difficult it would be, for example, to barter an automobile for clothes and food

Publishers' Photo Service

A GOLD MINE in South Dakota. From the rocks below ground here, more than $250,000,000 worth of gold has been taken.

and room rent. And how awkward it would be to be paid only shoes or canned goods for wages, instead of money! It is because we have money to help us in the exchange of goods that we can have our many comforts and conveniences of today.

For Your Museum

Do you have any old coins of the United States or coins of other countries? Perhaps you would like to lend them for a little while to your class museum. Have a class exhibit of old coins and new coins.

Drawing Time

Draw in your notebook pictures of the coins of the United States. You can make pictures easily by holding a thin sheet of paper over the coin and rubbing your pencil lightly over the whole of the coin.

Searching for Facts

From an encyclopedia, find out about the money system of England, France, Italy, or some other country. Compare this system with the money system of the United States.

From a bank get a printed list of the value of money in foreign countries. How much money of a foreign country is our dollar worth?

Find out how many mints there are in the United States and where they are located.

Explain the statement, "Today we have a good system of money to use."

A Picture Summary

Draw two pictures. Call one "Shopping in Primitive Times" and the other "Shopping Today." If you plan your pictures carefully before you draw them they will give a clear summary of this story.

Explaining a Fact

On page 542 in this story you read that "Spain had grown rich." Can you tell why?

9

Using Money Wisely

Money is one of the handy tools that makes our living possible in the age of machines. But, as with any other tool, you must learn to use it properly if you want it to serve you well. Money by itself is of no use. You cannot eat a dime if you are hungry. A silver quarter will not keep you warm if you are cold. A five-dollar bill will not make you a comfortable pair of shoes. It is only when we exchange the money for food and clothes, and other things, that it is of any value to us.

Today it is almost impossible for most of us to get along without some money. If we learn to use our money wisely—to buy the things we need, the things we want, the things we wish to give to our friends and to those who are in need, and to save some of it to spend later on—we are happy. If we use money foolishly we are unhappy.

One of the first things that you should learn about the management of money is not to spend more than your income. Income is the amount of money you receive each week, or each month, or each year. Perhaps some of you receive a small weekly allowance from your parents. Some of you earn money and others perhaps have very little money now to call their own. The less money anybody has, the more carefully he must use it so that he can get the most out of it.

In the famous book called *David Copperfield,* written by Charles Dickens, Mr. Micawber, who had always spent his money foolishly, makes a very wise remark. At one time he says to young David, "My boy, remember this!

Income = 20 shillings;
expenses = 21 shillings;
result = misery.

But income = 20 shillings;
expenses = 19 shillings;
result = happiness!"

The person who is in debt cannot be so comfortable and happy as the man who owes no money to another man. Today many people buy things on the installment plan when they should not do so. Others spend money foolishly and do not get real value in return for it. But the person who has really learned good ways of living in the machine age does four things well. He (1) earns money and saves part of it; (2) spends less than his income; (3) distributes it wisely over his needs, wishes, and giving; and (4) gets full value for what he spends.

The best way to manage what money you have is to make a budget or plan for the use of your money. This means keeping a written account of the money which is coming to you and the way you plan to spend it. You might also keep an account of your income and expenses, day by day, in a notebook that you make for yourself. An easy way to do all this would be to rule a page for each week something like this:

Income:

	Save	*Needs*	*Wishes*	*Give*	*Total*
Budget Plan					
Money Used					
Date					
Date					
Date					
Date					
Date					
Date					

At the beginning of the week write down opposite "Income" the amount of money you expect to have during the week. Next, make a budget plan of how you think it would be wise to spend your money. Then keep a record of exactly what you spend each day.

Those of you who have no regular allowance can hunt around for ways to earn money. Perhaps your parents, friends, and teachers will tell you of ways to earn extra nickels and dimes. Since money for most of us is hard to get, we should ask ourselves the following questions before we buy an article:

1. Do I need it?
2. Can I afford it?
3. Shall I get my money's worth?
4. Will it satisfy me after I buy it?

If we think about these things before we buy, we will not part with our money foolishly.

If you will start right now to practice using the tool of money wisely, you will be happier in this age of machines when you become a man or woman and are paid in money for the work you do in helping to make our ways of living.

Talk It Over

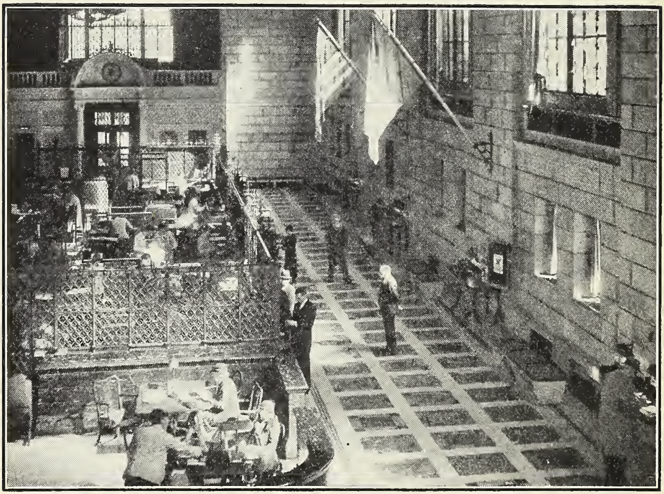
If you do not have a weekly allowance, talk the matter over with your parents to see if you may have one. If your parents can give you an allowance, decide with them just what it should be used for.

Budgeting

Make a budget for yourself and see how long you can keep it.

10

Money at Work



Gendreau

IN A LARGE CITY BANK, where much money is handled.

In the story before this you learned that if you are to use money wisely you must save part of your income. Then you will have some money to use when you need it. Many children have penny banks or dime banks in their homes. In this age of machines there are also banks where it is safe to put large amounts of money. Perhaps you have a savings account in one of the banks in your community. Perhaps you have a bank day in your school when you can place your savings in the bank.

Today when we "deposit" money in a bank we feel sure that we can get it when we need it to use. But savings banks do more for us than just protect our money. They pay us to deposit it there. So not only is your money safe in the bank but it earns money for you. Do you know how this is so? After you deposit your money in the bank it goes to work for you. That is, the bank loans your money to people, factories, and businesses that need it. These people are glad to pay the bank *interest* for the use of your money. And the bank pays you a part of the money it gets as interest. Sometimes interest paid you by a bank on one dollar for a year is 3 cents.

If you have a savings account, it is fun to watch how the interest makes it grow. You must remember that your money is safe at work with no trouble for you. The bankers are careful to loan your money only when they are sure it will be safe so that they can pay it back to you when you want it to use. Some bankers in earlier years were not always able to manage money wisely, and some of their banks failed. A few other bankers were dishonest. The government now makes strict rules for banks. In this way the government helps to protect your money.

Almost everything we use in this age of machines is paid for with money. Banks loan money to men who make buildings, roads, and goods. Banks help to make our ways of living possible. Yet men have not always had banks to help them. We know that some of the ancient nations had systems of banking. After the breakup of the Roman Empire the Roman banks as well as the Roman money were no longer used.

By 1300 A.D. Venice had worked out a banking system. The merchants of Venice needed banks to help them in their trading. The word *bank,* at first, meant "bench." The early bankers hundreds of years ago in Italy sat at little benches in the market place. There they changed money for the people. A banker is really a man who is trusted with money belonging to someone else.

In those days it was very dangerous to travel with money. Robbers often waited on roads to steal gold and silver from travelers. When a merchant in one place wanted to pay some money to a man in another city, he was afraid to send his gold and silver to him by a messenger. So he went to the bench in the market place and gave the banker his money. The banker gave him a little piece of paper called a *draft.* The draft was simply a letter to a banker in the other city, telling him to pay a certain sum of money to the person whose name was on the draft. The merchant could carry or send this draft safely. Even if it were stolen by robbers, they could not get money for it. The banker would not pay the money to any one except the person named in the draft.

Bankers of the Middle Ages, at their benches in the market place of an Italian city.

Our system of banking goes back to England. At the time of the Pilgrims there were no banks in England. The rich merchants of London kept large sums of gold and silver in their shops. Often they were robbed. At last the merchants decided to take their money to the goldsmith. He could guard it well for them, because he had to keep his own gold well guarded all the time.

The goldsmiths found that they could loan the merchants' money and make money for themselves. They charged enough interest for the money they loaned so that they could pay the merchants interest and have a profit for themselves. Thus the goldsmith became the banker in England.

It was not always convenient for a merchant to get his money from the goldsmith when he wanted to use it. He wrote a letter or draft to the goldsmith telling him to pay so much money to the person named in the letter. At first these letters were long. Then the merchants saved time by writing shorter and shorter letters. Finally the letters became the simple checks of today.

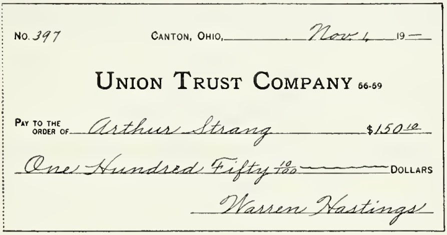
You see that checks really take the place of money. Not many checks, however, were used in the United States until after 1850. Even at the time of the war in 1861–1865 it was a common thing for a rich man to take his money bags in his carriage and pay his bills with gold and silver. How much easier and safer it is to write a check than to carry money about with us!

We are fortunate today to have a system of banking. Businessmen and people of the machine age have grown so used to banks that they could not get along without them.

Explaining

1. On page 551 you will find these words: "After you deposit your money in the bank it . . . goes to work for you." Explain this statement.

2. Explain the following:



No. 397 CANTON, OHIO, Nov. 1 19—

UNION TRUST COMPANY 66-59

PAY TO THE ORDER OF Arthur Strang $150 00

One Hundred Fifty $\frac{00}{100}$ DOLLARS

Warren Hastings

Schoolroom Bank

Would you like to turn your schoolroom into a bank for a few minutes each week? Before you do this, visit a bank in your community to see how it looks and what different kinds of work the workers in a bank do. Perhaps your class could start a savings account to buy something for your room.

Word Study

Be certain to learn what these words mean: *bank, check, interest, draft.*

11

Some Things to Think About

The age of machines helps to make your ways of living what they are. If you are to live happily in the age of machines you must think about these things:

1. The kind of work you are going to do.
2. The kind of education that will help you to do your work well.
3. The way you can use wisely the money you earn.

Matching Test

Connect the words in the following list with their definitions. In your notebook or on a sheet of paper write the numbers 1 to 15; and after each number write the letter giving the definition of the word so numbered. For example, 9 (*g*) would mean "9. guild: (*g*) A society of master workmen in times long ago."

1. draft
2. apprentice
3. machinist
4. barter
5. budget

(*a*) The exchange of one thing for another
(*b*) A plan of how to spend our income
(*c*) An order from one bank to another directing the payment of money
(*d*) A person who is learning a trade
(*e*) A person who has learned to operate machines
(*f*) Means of travel by air

6. journeyman
7. treasury
8. mint
9. guild
10. stenographer

(*g*) A society of master workmen in times long ago
(*h*) A place where money is coined
(*j*) A craftsman who works with silver
(*k*) A person who writes shorthand and uses a typewriter
(*l*) A place where stores of wealth are kept
(*m*) A craftsman long ago who could travel around and work at his trade for money

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11. interest
12. check
13. craftsman
14. clerk
15. coins

(*n*) The sum paid each year by a person to an insurance company
(*o*) A person employed to keep records
(*p*) A written order to a bank to pay money
(*q*) Money made of gold or silver or nickel or copper
(*r*) One who makes things by hand for his trade
(*s*) Money paid for the use of borrowed money

Reading Time

Magazines and newspapers will tell stories of some of the things we can do to live wisely in the age of machines. In the books listed below you can find stories that tell about such things as money, schools, and working.

Ambler, Mary B., *Man and His Riches.*
Carter, Mary Duncan, *Story of Money.*
Hurley, Beatrice D., and Sartorius, Ina, *School Boys of Long Ago.*
Johnson, William H., *Chicago.*

Pritchard, Myron T., and Turkington, Grace A., *Stories of Thrift for Young Americans.*
Unit Study Books No. 606: *Money.*

Talking Time

In Johnson's *Chicago,* on pages 157–175, you can find how the people of that community earn their living.

You can find two stories about school and its importance to our ways of living in Carpenter, *Ourselves and Our City,* pages 127–145, and Johnson, *Chicago,* pages 210–232. Be sure to look in encyclopedias, magazines, and your newspapers for more stories about schools.

For more information and ideas about money and its uses, see pages 196–208 in Carpenter, *Ourselves and Our City,* and the play called "A Boy and His Riches" on pages 209–214 of the same book.

12

More Time for Play

Donald's father is a carpenter. On weekdays he drives to work in his car. He leaves home before seven o'clock in the morning when he is working on a house that is more than thirty miles away. If he is helping to build a house near by, he does not have to start for work until half past seven. He begins his work at eight o'clock. He has a half hour for lunch at noon, and his day's work is over at half past four. On Saturdays he is through at noon. You see that there are many hours in the week when Donald's father does not have to work. There is an hour at home before dinner; there are the evenings; there is Saturday afternoon; and, of course, there is all day Sunday.

This time which workers have for themselves is called "leisure time." The word *leisure* really means "being allowed." Leisure time is time in which you do not have to work, but which you can have for yourself to do with as you please.

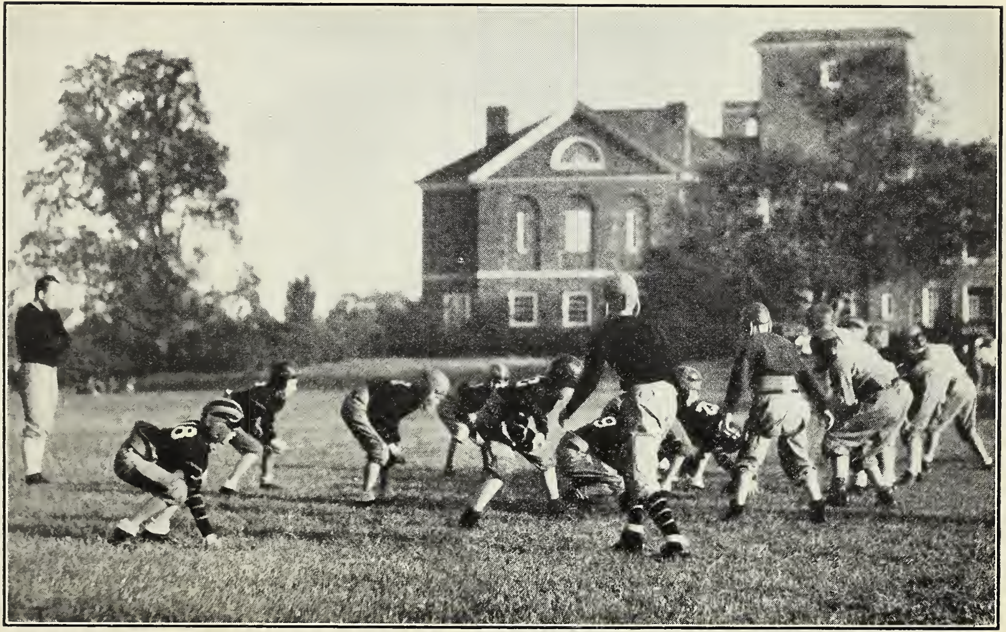
Donald's mother also has many hours of leisure time during the week, but probably she does not have so much leisure time as her husband. She begins getting breakfast at half past six and is usually busy until half past seven in the evening, when the dinner dishes are done. There may even be some mending to be done after that. On the other hand, Donald's mother may have a caller in the afternoon, or she may make a call, or go riding with a friend.

Gertrude's father works in a bank. He begins his day's work an hour later than Donald's father, and he has an hour at noon, but he works until five, and gets home just in time for dinner. It is probably very much the same with the parents of most of your classmates. They have about the same amount of leisure time every week. It does not make much difference if the fathers work in factories or in offices. Nearly all workers and their wives have a good deal of leisure time. The men have enough hours to make about three whole days of leisure time every week, not counting meal time, or sleeping, or Sundays.

If those of you whose grandfathers are living should ask them how long they used to work every day, you would find out that they worked many more hours in a week than your fathers do now. You can easily guess why they did. They did not have so many machines or such good ones to help them in their work. You know that in colonial times, when people worked with hand tools, their work was so slow that they had to toil long hours to make a living. Machines give all workers more leisure time by helping them to do the necessary work very quickly. Then there is time left for reading, visiting, listening to the radio, playing a musical instrument, making something we like, and going to the movies.

Here you see part of a public park and beach, provided for the recreation of many people.

All these things which bring a welcome change from work and which people do in their leisure time, are called *recreation.* The word *recreation* comes from a word that means "to create again." When we play and amuse ourselves in our leisure time, we make new strength to use when we work. Boys and girls have many hours for recreation every day. You have recess at school, afternoons after school, evenings, Saturdays, and Sundays. Our new age of machines gives us all this time for recreation. Boys and girls in colonial times had to help their fathers and mothers much more than you have to, because there were no



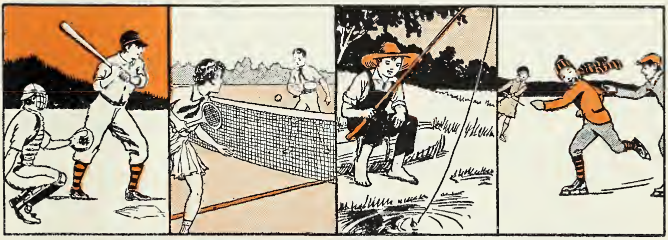
H. Armstrong Roberts

How is the football game helped by the work of machines?

machines to shorten the hours of work at home. It is really because of machines that you can belong to the Boy Scouts or Girl Scouts, and go on your hiking and camping trips. Machines give you time to play baseball and football, to go swimming and skating, to go to the movies and to listen to the radio at home.

We have to thank our machines not only for giving us more leisure time, but for making most of the things we use for recreation. Machines make baseball bats, fielders' gloves, catchers' mitts, and baseball suits and shoes. Machines cut and bend the wood for tennis rackets, snowshoes, and skis. Skates, sleds, bicycles, and scooters are made by machines. Before our age of machines, all the handmade goods used in sports were so expensive that only a few people could afford to buy them.

Because you have read stories on transportation, you can see how automobiles, streetcars, trains, and busses carry thousands of people long distances to places where they can enjoy recreation. Before we



How do you spend your leisure time? Do you play baseball or tennis? Do you fish? Do you skate? What other things do you do?

had these machines to take us to the seashore, to rivers and lakes, to baseball games, and to football games, only those who lived near by, or who had horses and carriages, could go to the places of recreation. Today many families think nothing of riding twenty or forty miles to pay an evening visit to friends living in another town.

Many of the things that we most enjoy are gifts of the machine age. The moving-picture and sound-picture machines are not only wonderful machines themselves, but they are made by other even more wonderful machines. The same is true of your radio. Machines print the funny page you like to read, the books and pictures you enjoy, and the stamps you collect. If your father finds his recreation in fishing, hunting, playing golf, or making a garden, nearly everything he uses in these recreations, or *hobbies*, is made by machines. If you make airplane models, or paint pictures, or take snapshots with your camera, you use materials which machines have made handy to use and cheap to buy. You cannot even go for a picnic without sharing the gifts of our machine age —the paper cups and plates, the oiled paper for sandwiches, and the car you ride in. All your many indoor games and paper caps and favors for parties are machine-made and cheap to buy.

* * * *

In this book you have read other stories telling how machines have given us new and better ways of working, of making goods, and of traveling from place to place. Do you understand from this story how machines have also given all of us more time for play and recreation, how they have brought us many kinds of enjoyment which people did not have before, and how they have made everything that we use in recreation cheap enough for most of us to have?

Writing Time

Write a theme called "My Hobby," and tell in it:

What your hobby is.
Why you chose it for your hobby.
How often you enjoy it.

My Journey Plan

Traveling is a very interesting way to spend leisure time. Usually before people start out they plan their trip carefully. They study maps to plan their route. They look at pictures to find out what they will see. They try to find out from books what kind of food they will eat, what kind of clothes to wear, and what kind of money to use.

Plan to take a trip around the world. Make a plan book called "A Plan of My Journey around the World." For it, do the five things listed on the next page.

1. On an outline map trace the routes you will take and write in the names of the places where you will stop.
2. Choose pictures that show the methods of transportation you will use.
3. Make a list of the kind of clothes you will use at the different stops.
4. Find pictures for the different kinds of food you will eat.
5. Find pictures of the buildings, people, and scenery you will see.

The Movies

Do you like to go to the movies? Tell the class about the best movie you have seen. Why did you like the movie?

Radio

Tell the class about the most interesting radio program you have heard. Is the radio a help to recreation?

Something to Think About

Think carefully about the many things you do in your leisure time. Do you find that some of the things you do add very little to the enjoyment and understanding of your ways of living? What changes do you think you should make in your use of leisure time?

13

Made by Machines for You

"Here is the wallpaper I like, Mother—this pretty blue with the little white flowers all over it."

"That is certainly a lovely pattern, Martha. It is like a field of Queen Anne's lace, isn't it? But I am afraid it would not look well in our living room. You see, it is a bedroom paper. The soft plain cream on the next page would be better for a living room."

Martha and her mother were looking at the thick book of samples the paper hanger had left. Martha liked the many soft colors and attractive patterns and wished she could see the rooms papered with each one.

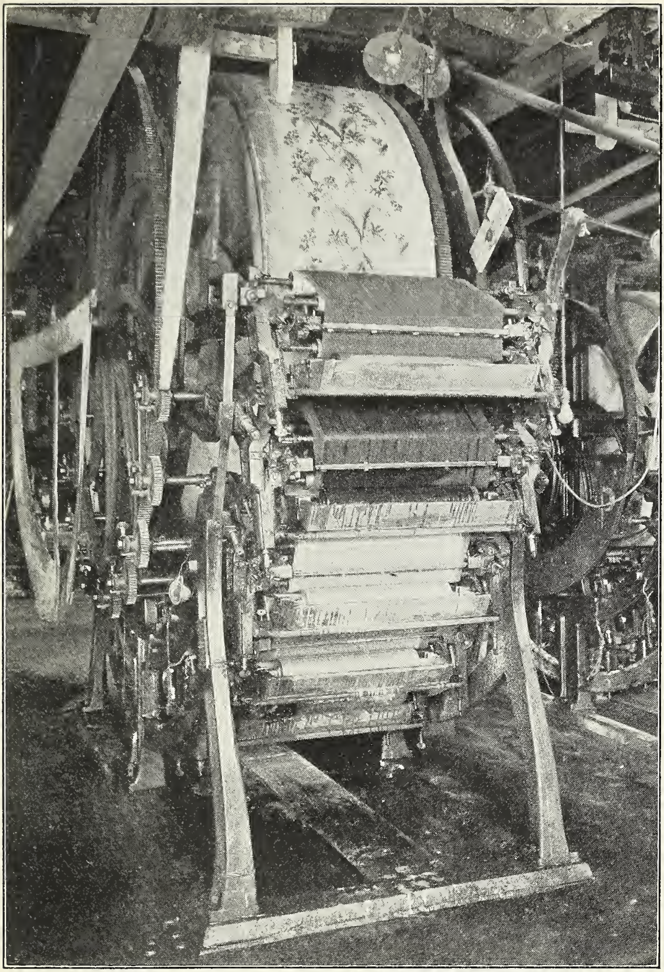
"I suppose people did not have wallpaper sample books to choose from in colonial days," said Martha, as she turned back to the beginning of the book to look again.

"Probably not," replied her mother, writing down the number of the pattern they had chosen. "Wallpaper was very expensive before the day of machines. The paper had to be cut and printed by hand. Today machines make the paper and the dyes, do the printing, and roll the paper in great rolls. And it is done so cheaply that people now can afford to have beautiful paper on the walls of almost every home.

Our home is much lovelier than it would be if there were no machines."

Martha's mother was right. Our homes today can be much more beautiful to look at and to live in than the ordinary home was a hundred years ago. Machines give us many things of beauty as well as things to use. Whenever a worker today has learned how to manage wisely the money he earns at his work, he can afford to buy the things that machines make to give us pleasure.

Let us look at some of the things in Martha's home that she could have because machines made them cheaply and her family saved money to buy them for the home. Let us pretend we can enter the big living room where the new wallpaper is to be hung. It is a long room, with many windows where the sun shines through curtains of machine-made lace. On the floor is a soft blue and brown rug; it was woven in a rug factory by machines. In one corner stands a shining piano of polished wood; it came from a piano factory where machines do most of the work. Along the walls are bookcases filled with books; they were printed by giant presses on machine-made paper, and the gold letters on the fine leather bindings were stamped by electric stamping machines. On a machine-carved table is a vase of clear glass. Hundreds of vases just like it came from the glass factory where it was made. Martha enjoys looking at it when it is filled with flowers from the garden. Near the window is an



Fairbanks, from Wallpaper Magazine

IN A WALLPAPER FACTORY. Many machines are used in printing wallpaper in different colors.

electric radio-phonograph. Beside it is a case full of phonograph records that preserve the music of the world's most famous singers and players. Martha can have music whenever she wants it. Over the comfortable divan, with its machine-woven upholstery, hangs a picture that Martha likes very much. It is a copy, printed by machines, of a painting of a Dutch girl sitting by a window. The original was painted long ago by one of the world's greatest artists and hangs in an art gallery in Europe.

By looking at the things in Martha's living room we can see how machines have helped to give us more beautiful homes and better opportunities to enjoy at very small cost the world's best literature, finest art, and greatest music. Outside the home, also, machines help very much in giving us pleasure. At the theater we see curtains that go up and down by machinery. The stage is lighted by electric lights. Machines make noises like wind and rain and thunder to go with the plays.

More important still, machines give us the "movies." Without the powerful lights and cameras and the machines that record sound, we could not have motion pictures and talking pictures. Machines make the films and then make thousands of copies of each film. Boys and girls in Massachusetts can go to the theater the same day that boys and girls are going in California and see exactly the same picture at the same time. The real actors can be in only one place at once; but

Fairbanks

How Movies Are Made. You see the two actors at the left; beyond and above, the floodlight needed; at the right, the large camera that is making the picture film. Many machines and many carefully trained workers are required to make a picture.

their pictures, made by machines, can be in hundreds of places at once, for all of us to enjoy.

Machines also provide ways for us to travel. In boats, automobiles, trains, and airplanes we can go long distances to see the beauties of the world. Machines give us opera glasses with which to look at things, and cameras with which to take pictures. If we play games, machines help to bring the cost of the game equipment down to where we can afford to buy it and enjoy the games. A baseball or a football or a tennis ball costs very much less now than it would if handmade. If we like to paint pictures, we can buy paints and brushes and paper that are made cheaply by machines. If we like to fish, machine-made fishing rods and lines and hooks can be bought. Machines make skis and skates, gliders and bicycles. Thousands of different things that give us enjoyment are manufactured by machines.

No matter where we go or what we do, our lives are made more pleasant because we have machines to work for us.

A Large Exhibit

As you have been reading these stories about the machine age you have been making many small exhibits. How should you like to have a large exhibit of the best of all the materials you have made and gathered during the year?

You could arrange your materials on tables or in booths. Each table or booth could illustrate one unit of the book. Or, you could make new models to illustrate the main idea of each unit.

Making Posters

You and your classmates may want to make six large posters to illustrate the units of this book. Choose committees and let each committee work out one poster.

Giving a Play

You may like to have a play about "The Age of Machines—and You." To get ideas for your play you will want to read the last story over again and look through all of the other stories of the book. Your play might have six scenes:

1. How communication makes our ways of living.
2. How transportation makes our ways of living.
3. How machines make our ways of living.
4. How power makes our ways of living.
5. How the age of machines affects communities.
6. How the age of machines affects each of us.

In all of these scenes you must remember to bring out ideas which show how the age of machines makes your ways of living possible.

Reading Time

Encyclopedias, magazines, newspapers, and advertisements will tell you much about the many machine-made things that make our ways of living comfortable and pleasant. In the books that are listed on page 275 of this book you can find stories that tell about the things made in factories by the thousands and even the millions. Be sure to look in:

Carpenter, Frank G., and Carpenter, Frances, *The Clothes We Wear; The Foods We Eat; The Houses We Live In.*

Carpenter, Frances, *The Ways We Travel; Ourselves and Our City.*

Chamberlain, James F., *How We Are Clothed; How We Are Fed; How We Are Sheltered.*
Emerson, Caroline D., *Father's Big Improvements.*
Forman, S. E., *Stories of Useful Inventions.*
Ilin, M., *Turning Night into Day.*
Lacey, Ida Belle, *Light Then and Now.*

Talking Time

In S. E. Forman's *Stories of Useful Inventions* you can find these stories to tell about the invention and improvement of these things we use in our homes.

"The Match," pages 3–12.
"The Stove," pages 13–27.
"The Lamp," pages 28–37.

The stories were written before you were born, and there may be some recent improvements that you should include if you tell the stories to the class. Look in the magazines for stories about household conveniences, such as electric refrigerators, plumbing fixtures, and other things that make our homes convenient.

Maybe someone can read the story of *Father's Big Improvements* and tell some of the things that happened to the family in the story when the new improvements were put in the home.

What other stories have you read about the things machines give you that would make interesting talks to the class? Look in the encyclopedia for stories of some of the things that you use every day.

Index

The pronunciation markings used in this book are: ā in fāte, ā̇ in vā̇cation, ă in căt, *ă* in mad*ă*m, ä in fär, ȧ in dȧnce, *ȧ* in sof*ȧ*, â in câre; ē in mē, ē̇ in rē̇turn, ĕ in mĕt, *ĕ* in mom*ĕ*nt, ẽ in uppẽr; ī in fīne, ĭ in pĭn, *ĭ* in char*ĭ*ty; K = the guttural sound of ch in the German word *ich;* N, itself not sounded, means a nasal tone for the preceding vowel, as in the French word *bon;* ō in bōne, ō̇ in ō̇bey, ŏ in nŏt, *ŏ* in c*ŏ*nnect, ô in ôrder, o͞o in mo͞on, o͝o in fo͝ot; ū in ūse, ū̇ in ū̇nite, ŭ in ŭp, *ŭ* in circ*ŭ*s, û in ûrge.

Note: Names of make-believe persons, such as Miss Abbott (page 5), Amos Collins (page 101), the Penningtons (page 201), and Grandfather Jenkins (page 411), are not included in this Index.

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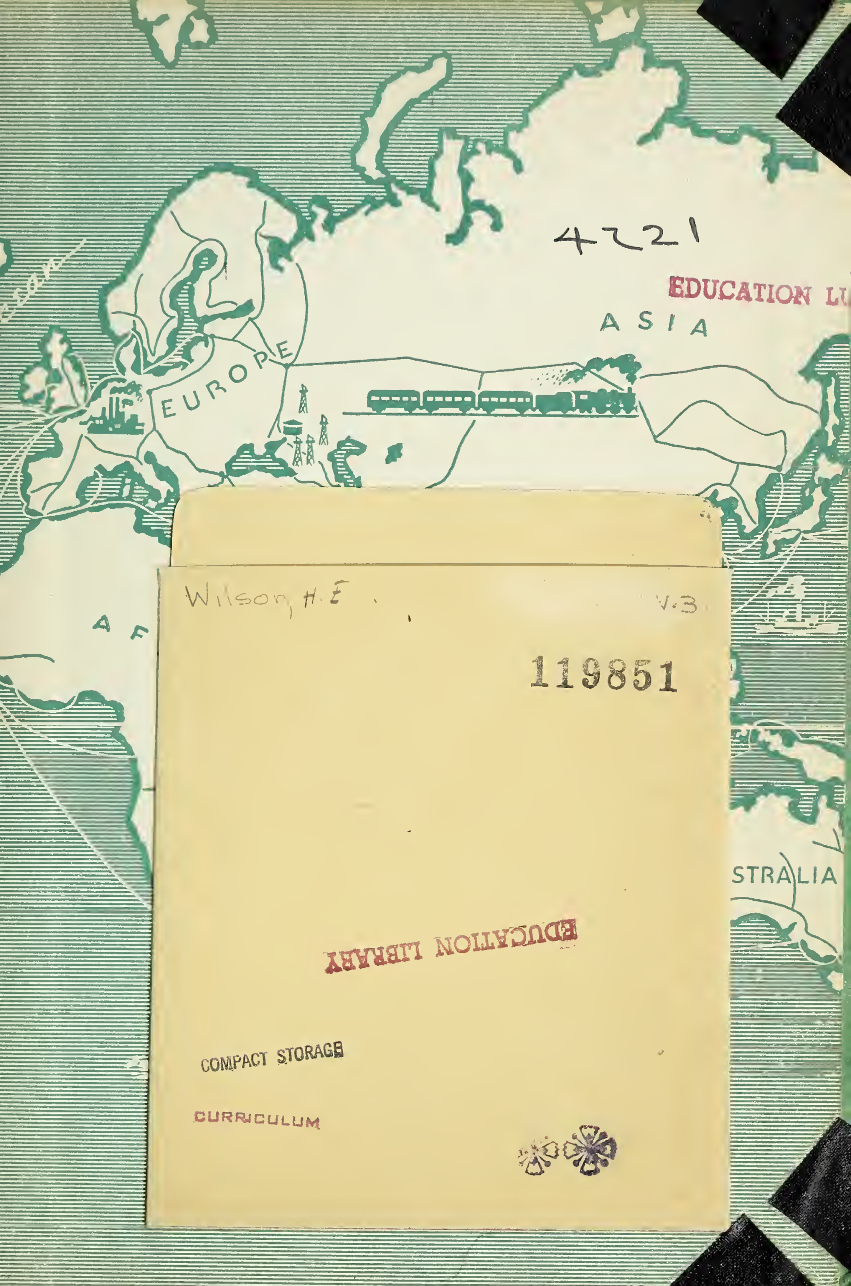

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